PowerWAVE
6000 Series 3

60-120 kVA
User Manual

Uninterruptible Power Supplies Ltd
A KOHLER COMPANY

Document Control

ISSUE	DATE	REVISION SUMMARY
765-01-00_A	25/11/2014	Initial draft copy published for proof reading.
765-01-00	20/12//2014	Initial issue

Uninterruptible Power Supplies Ltd has taken every precaution to produce an accurate, complete and easy to understand manual and will therefore assume no responsibility nor liability for direct, indirect or accidental personal or material damage due to any misinterpretation of or accidental mistakes in this manual.

© 2005 Uninterruptible Power Supplies Ltd

This manual may not be copied nor reproduced without written permission of Uninterruptible Power Supplies Ltd.

Table of Contents

Safety 1

1.1 Description of symbols used in this manual 1
1.2 User precautions 1
1.3 Declaration of Safety conformity and CE marking 2

Description 3

2.1 Introduction 3
2.1.1 Reliability and quality standards 3
2.1.2 Key features 3
2.2 PowerWAVE PW6000 S3 Model range 4
2.2.1 Single/Multi system configurations 4
2.3 PowerWAVE PW6000 S3 UPS module functional description 5
2.3.1 UPS module block diagram 5
2.3.2 UPS internal operating modes 6
2.3.3 System operating modes 8
2.3.4 Multi-cabinet parallel system concept 8
2.4 PowerWAVE PW6000 S3 User Controls 11
2.4.1 Power isolators 11
2.4.2 UPS Control panel 12
2.5 LCD Control Panel 12
2.5.1 Module mimic LED indicators 12
2.5.2 Operator keys 13
2.5.3 Power Management Display (PMD) 14
2.6 UPS Communication interface 18

Installation 20

3.1 Introduction 20
3.2 Taking receipt of the UPS 20
3.2.1 Site transportation 21
3.3 Storage 21
3.4 Unpacking 21
3.5 Planning the installation (site considerations) 24
3.5.1 Clearances 24
3.6 Planning the installation (cabling considerations) 25
3.6.1 General requirements 25
3.6.2 Cable and fuse sizing 25
3.6.3 Power cable termination details 28
3.6.4 Power cabling in a parallel system 29
3.7 UPS Cabling procedure 30
3.7.1 Connecting the input cables 30
3.7.2 Connecting the UPS output cables 31
3.8 Battery connections 32
3.8.1 External battery enclosure 32
3.9 Multi-module control cabling and configuration 33
3.9.1 Connecting the parallel communication bus cables 33
3.9.2 Configuration DIP switch selection 34

Operation 35

4.1 Introduction 35
4.1.1 Operating procedure summary 35
4.2 Initial system power-up and functional testing 36

4.3 System shutdown to maintenance bypass 39
4.4 System start-up from maintenance bypass 40
4.5 Individual module stop/start procedure 41
4.5.1 Single module system and capacity parallel module system 41
4.5.2 Redundant parallel module system 43
4.5.3 Complete system shutdown 44

Maintenance 45

5.1 Introduction 45
5.2 User responsibilities 45
5.3 Routine maintenance 45
5.4 Battery testing 46

Troubleshooting 47

6.1 Alarms 47
6.2 LCD Control panel 47
6.3 Troubleshooting table 48
6.4 Contacting service 48

Options 49

7.1 Introduction 49
7.2 Customer inputs (X1) 50
7.2.1 Remote shutdown (Emergency Power Off) 50
7.2.2 Generator ON facilities 51
7.3 Customer outputs (+USB) 51
7.4 Serial RS232 Computer interface – USB & JD1 (Smart Port) 52
7.5 RS485 Interface for multidrop 52
7.6 SNMP Card slots 53
7.7 WAVEMON Shutdown and monitoring software (instead of SNMP card) 54
7.8 PowerREPORTER™ management software 55
7.8.1 Functional description 55

Specification 57

8.1 General specifications 57
8.2 60-120kVA Fuses & cables quick reference 61

1 Safety

1.1 Description of symbols used in this manual

WARNING: The warning symbol is used where there is danger of an electrical shock, equipment damage or personal-injury.

CAUTION: The caution symbol is used to highlight important information to avoid possible equipment malfunction or damage.

1.2 User precautions

WARNING: Keep this manual with the UPS for future reference.

WARNING: The UPS and peripheral equipment must be installed and commissioned by suitably qualified and trained personnel who are aware of the potential shock hazards.

WARNING: Do not attempt to install this UPS system until you are satisfied that ALL the safety instructions and hazard warnings contained in this manual are read and fully understood.

WARNING: High leakage current!
Ensure that the UPS has been correctly earthed before you connect the mains power supply!

WARNING: This UPS must not be started-up or put into use without having first been commissioned by a fully trained engineer authorised by the manufacturer.

WARNING: This UPS must be serviced by qualified personnel.
You run risk of exposure to dangerous voltages if you open or remove the UPS-covers! Uninterruptible Power Supplies Ltd will assume no responsibility nor liability due to incorrect operation or manipulation of the UPS.

WARNING: The PowerWAVE PW6000 S3 is a Class A UPS product (according to EN 62040-3). In a domestic environment the UPS may cause radio interference. In such an environment the user may be required to undertake additional measures.

1.3 Declaration of Safety conformity and CE marking

The PowerWAVE PW6000 S3 UPS system is designed and manufactured in accordance with Quality Management Systems standard EN ISO 9001. The CE marking indicates conformity to the EEC Directive by the application of the following standards in accordance with the specifications of the harmonized standards:

- 2006/95/EC Low voltage directive
- 2004/108/EC Electromagnetic Compatibility directive (EMC)

Standards as reference:

- EN-IEC 62040-1 –
  Uninterruptible power supply (UPS). Part 1-1: General and safety requirements for UPS's used in accessible areas by end users.
- EN-IEC 60950-1 –
  IT equipment. Safety. Part 1: General requirements
- EN-IEC 62040-2 –
  Uninterruptible power supply (UPS). Part 2: EMC requirements
- EN-IEC 62040-3 –
  Uninterruptible power systems (UPS). Part 3: Performance and test requirements
- 2011/65/EU –
  Restriction of the use of certain hazardous substances (RoHS) DIRECTIVE

The supplier's responsibility is excluded in the event of any modification or intervention in the product carried out be the customer.

	Product Standards	Standards
Safety	EC/EN 62040-1	EC/EN 60950-1
Electromagnetic Compatibility (EMC)	IEC/EN 62040-2 (C1)	IEC/EN 61000-4-2 IEC/EN 61000-4-3 IEC/EN 61000-4-4 IEC/EN 61000-4-5 IEC/EN 61000-4-6 IEC/EN 61000-4-8 IEC/EN 61000-2-2
RoHS	EN50581:2012	EN50581:2012

2 Description

2.1 Introduction

Congratulations on your purchase of the PowerWAVE PW6000 S3 UPS.

Continuous power availability is essential in today's dynamic IT and process-related work environments. It is equally important that any installed power protection system is sufficiently resilient and adaptable to handle any requirement changes brought about by the introduction of new server technologies, migration and centralization.

Such demands are well met by the PowerWAVE PW6000 S3 UPS system, which provides the foundation for continuous power availability of network-critical infrastructures both in enterprise data centres, where business continuity has paramount importance, and in process control environments, where manufacturing continuity is essential.

2.1.1 Reliability and quality standards

The PowerWAVE PW6000 S3 UPS is available over a model range of 60kVA to 120kVA and incorporates the latest technological developments in power engineering. Representing a completely new generation of high power three phase UPS systems, its advanced double conversion VFI (Voltage and Frequency Independent) topology responds fully to both the highest availability and environmentally friendly requirements compliant with IEC 62040-3 (VFI-SS-111) standards.

Uninterruptible Power Supplies Ltd. specialises in the installation and maintenance of Uninterruptible Power Systems; and this powerful UPS is just one example of our wide range of state-of-the-art power protection devices that will provide your critical equipment with a steady and reliable power supply for many years.

2.1.2 Key features

High reliability, upgrade-ability, low operating costs and excellent electrical performance are just some of the highlights afforded by this innovative UPS solution. Other key features are shown below:

KEY FEATURES	
Compact size, small foot print	Space saving on expensive floor space
Flexible battery management	Advanced management of battery charging and preventive failure diagnostics avoids premature deterioration of battery life.
Best in class ac-ac efficiency, up to 96%	Energy-operational cost savings (TCO).
Low input power factor (near unity)	Cost savings during installation and the entire life cycle (TCO).
Blade-server-friendly power; full power from 0.9 lead to 0.9 lag	No de-rating required with leading power factor loads.
Very low input current distortion THDi THDi = < 4.0% @ 100% load	Gen-set power and installation cost saving

2.2 PowerWAVE PW6000 S3 Model range

The PowerWAVE PW6000 S3 UPS range includes 60, 80, 100 and 120kVA models, all of which are contained in the same size cabinet.

Mechanical details

	Unit	60	80	100	120
Photograph – front view with doors open					
Rated output power	kVA/kW	60/60	80/80	100/100	120/120
Cabinet dimensions (w x h x d)	mm	615 x 1954 x 480 without feet 615 x 1978 x 480 with feet			
Weight (excluding batteries)	kg	198	206	228	230

See Chapter 8 for a complete equipment specification.

2.2.1 Single/Multi system configurations

The PowerWAVE PW6000 S3 UPS can be configured to operate as a single, stand-alone UPS or as a multi-module parallel UPS system with up to ten UPS cabinets connected in parallel. A multi-module configuration is generally chosen either to increase a system's total power capacity or enhance the system's overall reliability by providing module redundancy.

Note: In this manual the terms 'multi-module system' and 'parallel system' are synonymous.

Key Point: In a parallel system ALL the connected modules must be of the same output rating – e.g. it is not permissible to connect 60kVA and 120kVA cabinets together in a parallel system.

Parallel system operation

When operating as part of a parallel UPS system, it is critical that various control functions such as load sharing, frequency synchronisation and load transfer are observed by all the connected UPS modules. This is achieved in the PowerWAVE PW6000 S3 UPS system by connecting by a parallel control bus between the UPS modules which allows them to communicate with each other continuously and carry out all necessary synchronous control operations.

Due to its Decentralised Parallel Architecture (DPA) design any one of the PowerWAVE PW6000 S3 UPS can take the leadership role when operating in a multi-module system. This ensures the highest possible level of power availability and avoids a single point of failure that can exist in other, more traditional, parallel systems.

Parallel system expansion

Most data centres present a low initial power demand which increases as the data centre grows to its full capacity; and it is essential that any installed power protection system can be expanded to meet the growing demand without compromising the existing load. This situation is easily managed in a PowerWAVE PW6000 S3 multi-module installation which allows an additional module(s) to be connected to an existing parallel system without having to temporarily transfer the load to the raw by-pass mains supply. Thus the load receives UPS protected power at all times during the upgrade process – without interruption.

2.3 PowerWAVE PW6000 S3 UPS module functional description

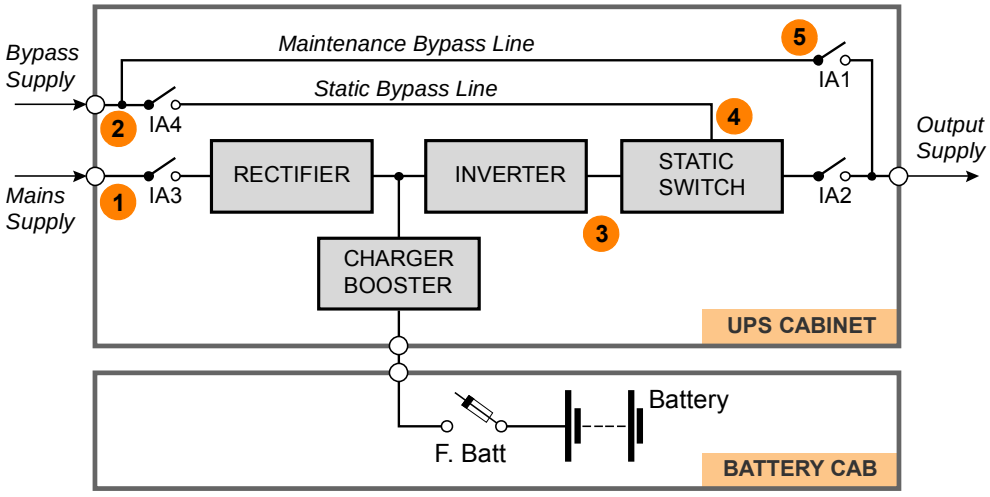


Figure 2.1 PowerWAVE PW6000 S3 UPS module block diagram

2.3.1 UPS module block diagram

Figure 2.1 shows the major power blocks contained within the UPS module.

UPS Input supplies

The UPS has two sets of three-phase input supply terminals. The 'mains supply' (1) is connected to the UPS rectifier via the input isolator (IA3) and during normal operation it is rectified to provide a DC input to the inverter and battery charger. The second three-phase input is connected to the 'bypass supply' terminals (2). In practise, the bypass supply terminals (2) are often linked to the mains supply terminals (1) within the UPS cabinet so the UPS effectively requires only one mains supply connection – see paragraph 3.6.2 for details concerning 'single feed' & 'dual feed' input configurations. The bypass supply is shown connected to the static switch (4) and the maintenance bypass line (5).

UPS Output (load) supply

Figure 2.1 shows that the UPS output (load supply) can be provided through one of three power paths from within the UPS, depending on the UPS operating mode:

- From the inverter (3), via the static switch and isolator IA2.
- From the static bypass line (4) via the bypass isolator IA4, the static switch and isolator IA2.
- From the maintenance bypass line (5) via the maintenance bypass isolator IA1.

The criteria for operating under each of these UPS modes is described below.

2.3.2 UPS internal operating modes

Load on Inverter

This is the normal operating mode and the only one that provides the load with continuously processed and backed-up power.

In this mode, the mains supply is converted to DC by the rectifier which then charges the battery and provides operating power for the inverter; which converts the rectifier output back into an AC supply that is suitable to power the load.

If the mains supply fails, or strays outside a preset acceptable voltage window, the rectifier shuts down and the battery provides an alternative DC power source for the inverter; which continues to operate until the battery is discharged.

When operating in the 'load on inverter' mode the inverter output frequency is synchronised to the bypass supply provided the bypass supply frequency remains within preset limits. If the bypass supply fails altogether, the inverter frequency is controlled by a free-running oscillator that will maintain the output frequency at a constant 50/60Hz.

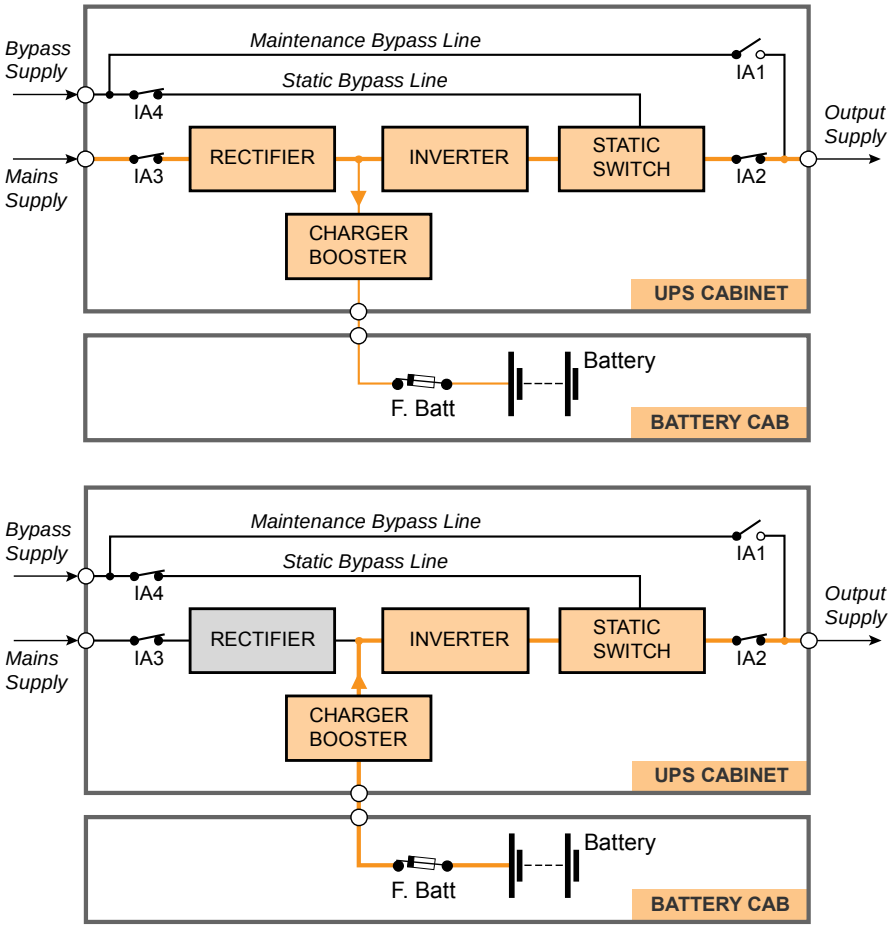


Figure 2.2 Load on inverter (from Mains or Battery power)

'On-battery' operation

Various alarms are generated as the battery discharges when the UPS is operating from battery power. This enables the operator to shut-down the load in an orderly manner if necessary (e.g. to save data) before the battery eventually reaches its end-of-discharge voltage and the UPS shuts down. Various options are available to automate the load shut-down process, as described in Chapter 7 of this manual (Options).

In practice, especially in larger UPS installations, the overall UPS system often includes a standby generator which starts automatically in the event of a mains supply failure and provides an alternative UPS input supply source until the utility mains supply returns to normal. In this scenario the battery is only required to support the inverter (load) until the generator comes on-line and, as a modern generator can be automatically started very quickly, this results in a relatively short battery discharge period – which helps to prolong the battery life.

Load on-bypass

In the load 'on-bypass' mode the load supply is connected to the unprocessed static bypass line via the static switch.

Depending on circuit conditions, when operating in this mode the rectifier and charger sections can be turned off entirely or remain running and continue to provide battery charging.

Similarly, the inverter can also remain in an operating (standby) state ready to be brought back into use.

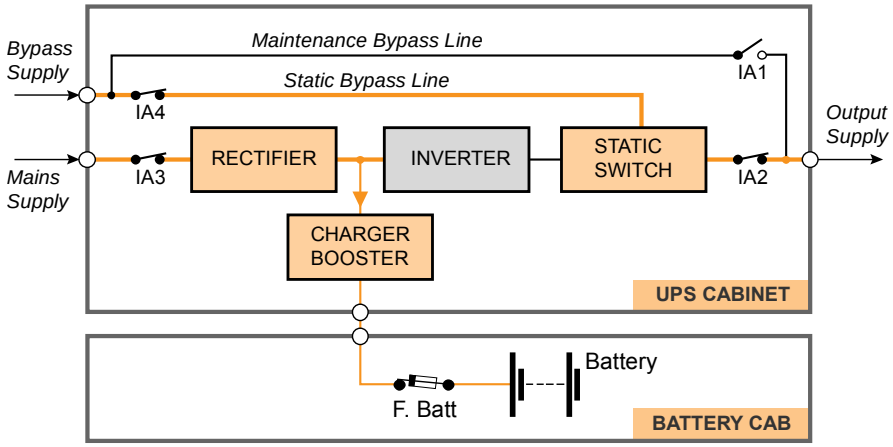


Figure 2.3 Load on bypass

Inverter/Bypass load transfer

As illustrated in the above diagrams, the load supply is connected to the inverter *or* static bypass line by means of the static switch. This is a solid state switch, operated by the UPS microprocessor control system, which allows the 'load on inverter' or 'load on bypass' operating modes to be selected either manually via the UPS control panel, or automatically by the UPS control logic *(see paragraph 2.3.3)*.

Load on maintenance bypass

In this mode of operation the manually closed maintenance bypass switch (IA1) connects the load supply directly to the raw bypass supply.

It is used to keep the load supplied (albeit without any power protection) whilst allowing the remainder of the UPS to be shut down for service repair.

Note that when operating in the maintenance bypass mode live voltages are still present on the UPS input and output power terminals.

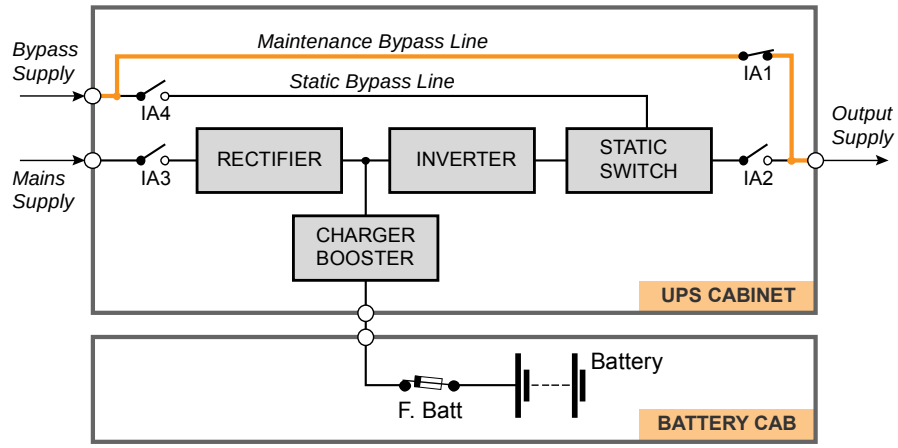


Figure 2.4 Load on maintenance bypass

To prevent possible inverter damage, it is important that the inverter output and maintenance bypass lines are never connected in parallel. Therefore when transferring from the 'load on inverter' mode to the 'load on maintenance bypass' mode it is important that the load is first transferred to the static bypass ('load on bypass' mode) before the maintenance bypass switch is closed.

CAUTION: Always follow the operating instructions in Chapter 4 of this manual when starting or shutting down the UPS.

2.3.3 System operating modes

Paragraph 2.3.2 described the various UPS internal operating modes: but UPS systems are also categorised according to the way in which they operate at a 'system' level, and are typically described as being either an 'on-line', 'off-line' or 'line interactive' UPS system.

The PowerWAVE PW6000 S3 can be operated in all three of the above categories.

On-line operation

When used as an 'on-line' UPS the PowerWAVE PW6000 S3 module(s) is configured to normally operate in the 'load on inverter' mode.

In the unlikely event of an inverter fault, or during an overload, the UPS will transfer the load to the static bypass automatically and without interruption (transfer time = 0). If the transfer is due to an overload the system will transfer back to the 'load on inverter' mode if the overload clears and the UPS will return to its normal 'load on inverter' operation.

Operating in the 'on-line' mode provides the highest degree of load protection, especially in the event of a mains disturbance or failure, and is always recommended if the critical load (e.g. computer system) will not tolerate even a very brief supply interruption.

Off-line / line interactive operation

When the PowerWAVE PW6000 S3 is used in an 'off-line' or 'line-interactive' mode the UPS module(s) normally operated in the 'load on bypass' mode, with the load being supplied from the static bypass supply. However the rectifier and battery charger are still powered up to maintain battery charging, and the inverter section is turned on and operating on standby.

In the event of a bypass supply error, or total failure, the load is automatically transferred to the inverter ('load on inverter') by the static switch within 3 to 5 milliseconds; and if the rectifier mains supply is also missing when the transfer takes place the inverter will support the load operating from battery power, as described above. If the bypass supply returns to normal the load is transferred back to the static bypass and the inverter returns to standby.

This mode of operation is slightly more energy efficient than the 'on-line' mode due to the reduced rectifier/inverter losses during normal operation; and it is sometimes referred to as the "ECO" mode. However this mode is recommended only if the connected load equipment can tolerate power interruptions of 3 to 5 ms during the transfer period.

WARNING: The on-line mode must always be used for critical load protection.

2.3.4 Multi-cabinet parallel system concept

Up to ten PowerWAVE PW6000 S3 UPS cabinets can be connected in parallel for increased capacity or redundancy operation. An example 3 module parallel system is shown in figure 2.5Figure 2.5.

Note: If a PowerWAVE PW6000 S3 is purchased as a stand-alone UPS it will require a field upgrade in order to be connected to a parallel system at a later time.

A PowerWAVE PW6000 S3 parallel system has a decentralised bypass architecture, in that each UPS module contains its own static bypass and static switch. This eliminates the need for a separate bypass cabinet, as required by some manufacturers' systems, and so eliminates a potential single point of failure.

In a multi-module parallel system the topology and internal operation of each UPS module is identical to that described previously for a stand-alone module, except that the UPS control logic is subject to additional 'system level' control functions which are delivered via a parallel control bus connected between each module.

As described below, the parallel control bus performs many functions including:

- System-wide load transfer control.
- Inter-module (and bypass) frequency synchronisation.
- Load sharing.

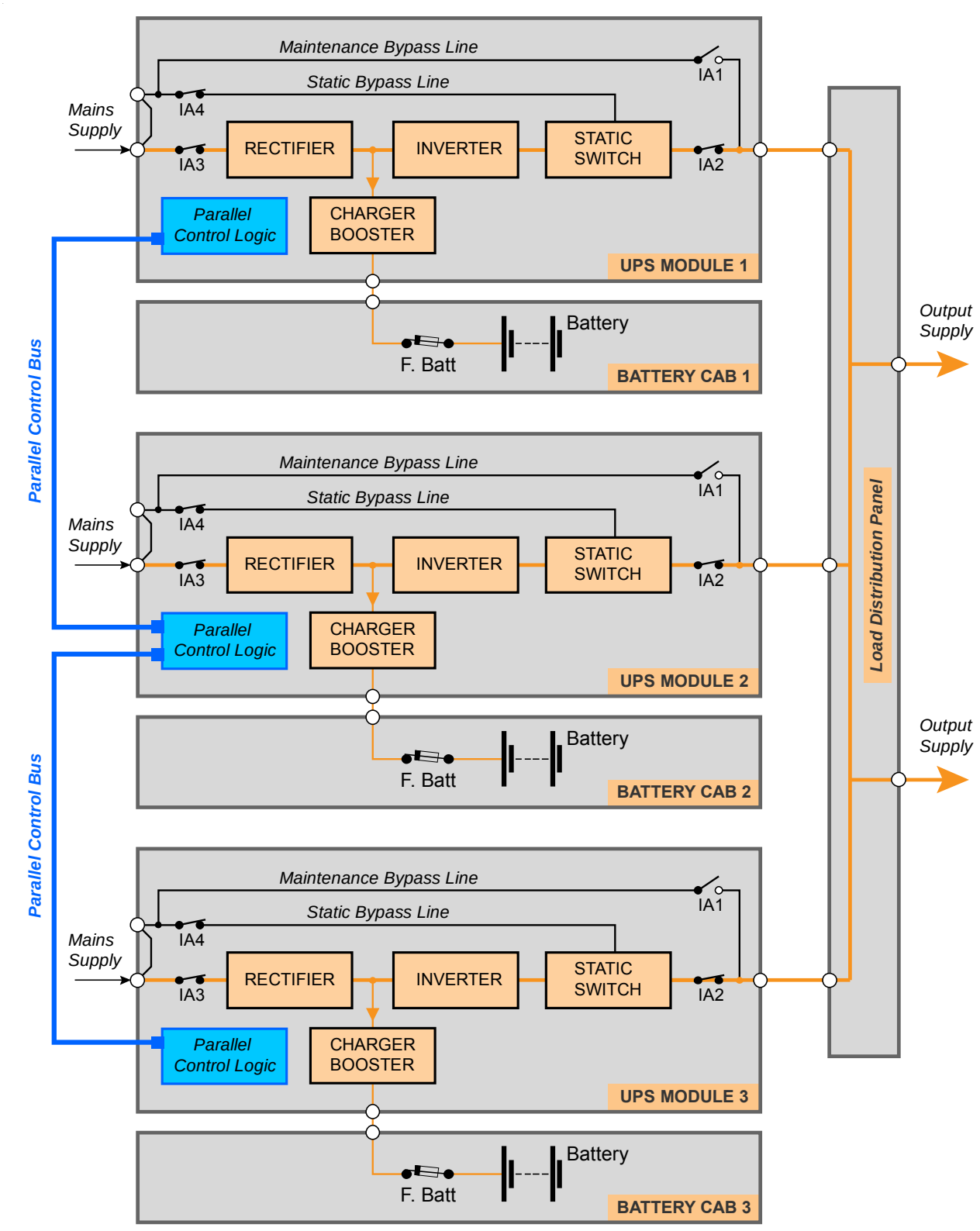


Figure 2.5 PowerWAVE PW6000 S3 UPS Parallel system

System-wide load transfer operation

All the modules that are connected to the load must be working in the same internal mode of operation at all times – i.e. it is not permissible for one module to operate in the 'load on inverter' mode while the remaining modules are in the 'load on bypass' mode – such a situation would likely damage the UPS modules' inverter or static switch.

In a parallel system therefore, if you activate the LOAD TO BYPASS command on *any one module* then all the modules will simultaneously switch to the 'load on bypass' mode. Conversely, when operating on bypass if you select the command LOAD TO INVERTER on any one module then all the UPS modules will simultaneously transfer the load to their inverters – provided a sufficient number of modules are operating to satisfy any system redundancy requirements.

Inter-module frequency synchronisation and load sharing

Using sensing signals passed over the parallel control bus, each UPS module can compare its own frequency and output current with that of its neighbouring module. This allows each module's control logic to carry out fine adjustments necessary to achieve balanced conditions.

The parallel control logic always observes one of the modules as being the 'master' and the other module(s) as 'slaves'. However if the 'master' module goes faulty at any time the next module in the chain (a former 'slave') will immediately take over the role of master, and the former master module will turn off. Master/slave configuration is achieved through selector switches located in each cabinet and is set-up during commissioning – see paragraph 3.9.

Module redundancy

If a system is designed with module redundancy then it contains at least one UPS module more than the number required to provide the specified system full load power.

For example, if the system shown in figure 2.5Figure 2.5 comprised 3x100kVA modules it could be employed as a redundant module system for a load of 200kVA. In this case under normal circumstances each module shares the load equally and supplies up to 66.6kVA at full load; but if one module fails, or is shut down, the two remaining modules can sustain the full rated load by each supplying 100kVA. The ability to lose one module yet still supply the full load with processed, backed-up power significantly increases the overall system reliability.

Two or more PowerWAVE PW6000 S3 UPS modules can be connected to a common battery to allow them to share the battery charging. However by employing a separate battery bank for each module, as illustrated in figure Figure 2.5, it again avoids a potential single point of failure and effectively extends the system redundancy to include the batteries. We highly recommend the use of individual batteries for each module.

Isolating a module from the system

If a parallel system incorporates module redundancy a module can be isolated from the system for service/repair purposes without affecting the operation of the remaining modules or load.

Every module has a parallel (output) isolator (IA2) which can be used to isolate the module from the load bus. When IA2 is open there is no load power being drawn from the module and it can be shut down in the normal way using the ON/OFF buttons on the UPS control panel; but in this case using these buttons will shut down the associated module only and will not cause the remaining modules to shutdown or transfer the load to bypass.

WARNING: When the UPS module is shut down its output terminals will be live even if the module's input mains and bypass supplies are isolated.

2.4 PowerWAVE PW6000 S3 User Controls

2.4.1 Power isolators

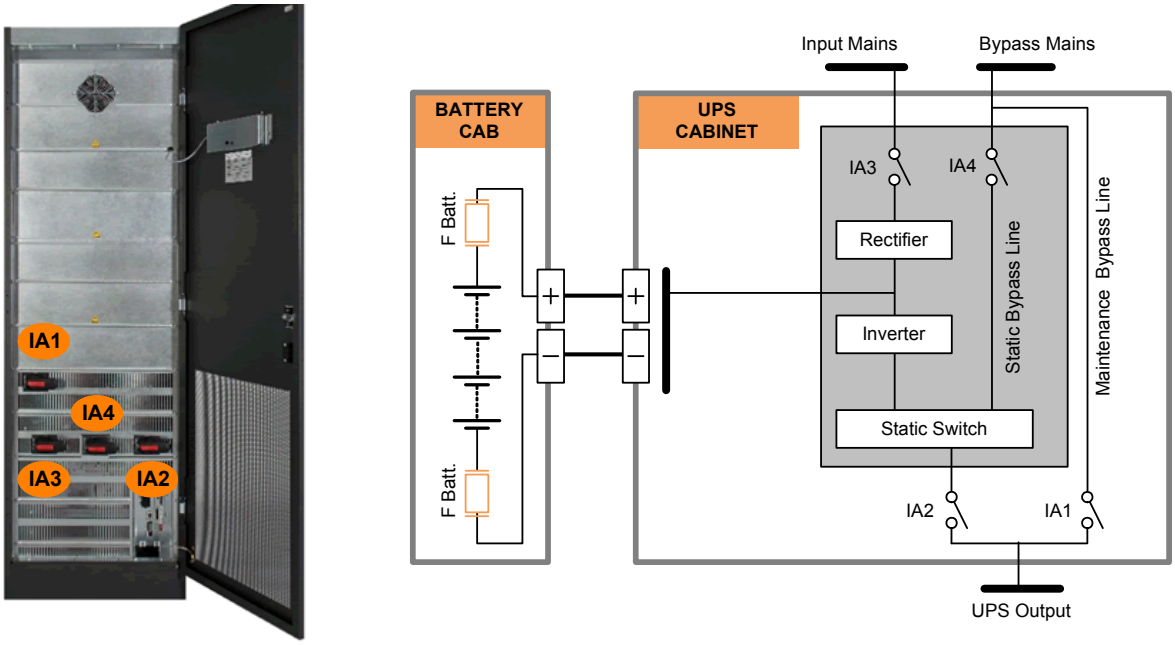


Figure 2.6 PowerWAVE PW6000 S3 power isolators

The PowerWAVE PW6000 S3 power isolators, shown in figure 2.6, are used during the UPS operating procedures when starting and shutting down the UPS.

IA1 Maintenance bypass isolator

IA1 connects the UPS output directly to the raw bypass mains supply and is OPEN during normal operation.

IA2 Parallel isolator

IA2 connects the UPS to the output (load) terminals and is normally CLOSED. This isolator can be used to disconnect the module from the load in a multi-module parallel system where necessary to carry out repair or servicing procedures.

IA3 Input mains isolator

IA3 connects the UPS input mains supply to the rectifier and is CLOSED during normal operation. If this isolator is opened while the UPS is turned on the UPS will immediately switch to 'on battery' mode and a several alarms will operated to inform the operator that the input supply has failed and the battery is on-load (discharging).

IA4 Bypass mains isolator

IA4 connects the UPS bypass mains supply to the static switch and is CLOSED during normal operation. If this isolator is opened while the UPS is turned on the UPS will continue to operate but the bypass supply will be unavailable to take over the UPS output supply in the event of an inverter failure.

2.4.2 UPS Control panel

An LCD control panel located on the front of the cabinet provides the means for day-to-day UPS operation and performance monitoring.

From the UPS control panel the operator can:

- Stop and start the UPS module.
- Transfer the UPS output (load) between the inverter and bypass.
- Monitor the UPS input/output voltage, current and frequency.
- Monitor the battery charge discharge current and battery status.
- Interact with monitored alarm and warning messages.
- Configure the UPS operating parameters (service mode).
- Interrogate the UPS operating events and alarm history (service mode).
- Carry out diagnostic actions (service mode).

2.5 LCD Control Panel

The LCD control panel is composed of three parts, shown below:

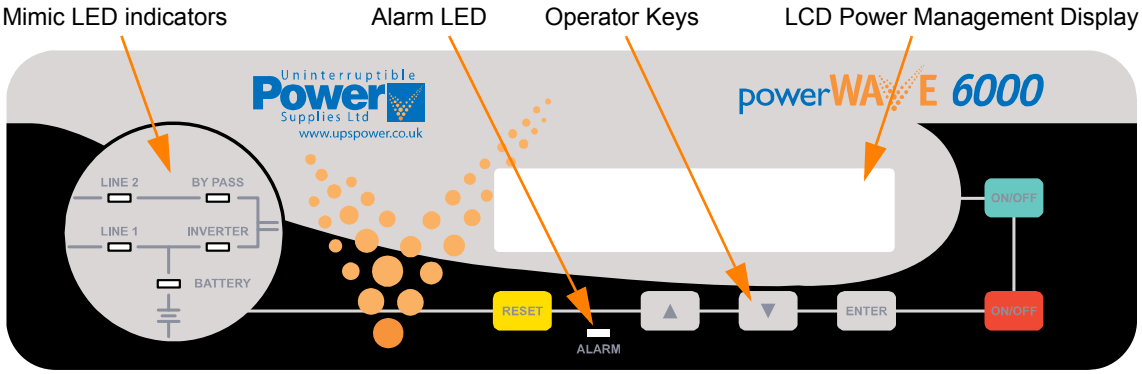


Figure 2.7 LCD Control panel

2.5.1 Module mimic LED indicators

The module mimic LEDs change colour between GREEN, RED and OFF to indicate the operational status of key UPS stages and thereby serve to show the active power path through the UPS.

- LINE 1 (rectifier) and LINE 2 (bypass) LEDs indicate the availability of the input mains and bypass mains supplies.
- INVERTER and BYPASS leds illuminate green to indicate which of the two sources is providing the load power.
- BATTERY illuminates green when the battery is being charged and flashes when the battery is discharging – e.g. when supplying the load following a mains failure.
- ALARM provides a visual indication that an internal or external alarm condition has been detected. When activated, it is accompanied by an audible alarm.

LED Indication summary

INDICATOR	STATUS	INTERPRETATION
LINE 1	GREEN RED	Mains available Mains not available
LINE 2	GREEN RED	Mains bypass OK Mains bypass not OK or not present
ALARM	OFF Flashing RED + buzzer RED	No alarm condition Alarm condition Alarm condition (has been reset)
INVERTER	GREEN RED OFF	Load on inverter Inverter fault Inverter not operating
BY-PASS	GREEN OFF	Load on bypass Bypass not operating
BATTERY	GREEN RED Flashing RED Flashing GREEN	Battery OK Battery fault or discharged Battery fuses blown On Battery

2.5.2 Operator keys

The operator keys allow the user to:

- Set operating parameters and make adjustments via the menu-driven LCD display.
- Start and stop the UPS, and transfer the load between inverter and bypass.
- Select the UPS operating voltages, currents, frequencies and other parameters to monitor on the LCD display.

Key function summary

KEYS	FUNCTION
ON/OFF ON/OFF	Used to switch-on or switch-off the UPS
UP (▲)	Scroll upwards through a displayed menu
DOWN (▼)	Scroll downwards through a displayed menu
RESET	Cancels the audible alarm. If the alarm condition was transient the ALARM LED will also extinguish, otherwise the LED will remain ON (red)
ENTER	Confirms (selects) a chosen menu item

ON/OFF Start-up and shutdown buttons

The UPS can be switched ON or OFF by simultaneously pressing both ON/OFF keys on the control panel. The requirement to press both buttons is to help avoid accidental operation.

During normal operation, pressing the two ON/OFF buttons simultaneously will immediately shutdown the UPS.

- In a single module installation this will disconnect the UPS output unless the load is first transferred to the maintenance bypass (see operating instructions).
- In a parallel module system the UPS module will shutdown and its output will be disconnected from the parallel load bus. However, the load may or may-not transfer to bypass depending on whether or not the number of remaining live modules satisfies the system's redundancy – i.e. if there are a sufficient number of modules remaining to support the system's load then the load will not be transferred.

To shut down all the modules in a parallel system you must press both ON/OFF buttons on every module.

2.5.3 Power Management Display (PMD)

The 2 x 20 character LCD Power management display simplifies communication with the UPS and also provides UPS monitoring information.

Status screens

DESCRIPTION	LCD-DISPLAY
1. Load is protected by UPS power supplied by inverter (normal operation).	LOAD P01 PROTECTED
2. Load is not protected by UPS power –supplied by mains power (load on bypass).	LOAD P01 NOT PROTECTED
3. Load supply interrupted. UPS has been switched off by "ON/OFF" buttons.	LOAD OFF P01 SUPPLY FAILURE
4. The UPS/module is not supplying load. The output switch is open.	LOAD DISCONNECTED P01 PARALLEL SWITCH OPEN

On the right hand side of the LCD-Display there is a 3 digit indicator which shows a module's position in a multi-module system. The maximum number of modules that can be used in a parallel system is 10.

S	Stands for **S**ingle module. The system consists only of one UPS cabinet.
P01	Stands for **P**arallel system and 01 identifies the cabinet as the 1st module (**MASTER)** in the system.
P02	Stands for **P**arallel system and 02 identifies the cabinet as the 2nd module (**SLAVE**) in the system. This number can range from 02 to 10 depending on the cabinet's position in the parallel system.

Setting the module position in a single/multi-module chain

Note: The position of a module in a multi-module configuration is set by DIP Switch SW1-9, which is located on the and set by the commissioning engineer. This switch should not be touched by the operator:

Main menu screen

DESCRIPTION	LCD-DISPLAY
1. A log of the last 64 events is stored in the Power Management Display.	→ EVENT LOG MEASUREMENTS
2. Allows monitoring of voltages, power, frequencies, currents, autonomy etc.	→ MEASUREMENTS COMMANDS
3. Enables the commands "Load to inverter", "Load to bypass" and "battery test" to be executed.	→ COMMANDS SET-UP DATA
4. Allows the UPS personalized information (such as serial number) to be entered.	→ SET-UP DATA SET-UP USER
5. Allows user to set up Date/Time, automatic battery test, etc.	→ SET-UP USER SET-UP SERVICE
6. Password-protected area for service engineer use only.	→ SET-UP SERVICE

Event log menu screen

DESCRIPTION	LCD-DISPLAY
1. Logging Control; a log of the last 64 events is stored in the Power Management Display.	01 05-10-08 14-38-56 LOAD TO INV.
2. Every stored event is identified with a sequential number and time stamp.	02 05-10-08 14-38-59 LOAD TO BYP.
3. By pressing ENTER the code of the event will be displayed.	03 05-10-08 14-39-14 LOAD OFF

Measurements menu screen

DESCRIPTION	LCD-DISPLAY
1. Battery Runtime.	BATT. RUN TIME (MIN) 00h 00mn
2. UPS-Output Frequency.	OUTPUT FREQUENCY (HZ) 50.00
3. Bypass Frequency.	BYPASS FREQUENCY (HZ) 50.00
4. Battery Voltage.	BATTERY VOLTAGE (V) +0.0 -0.0
5. Battery Charger Current.	BATT. CHARGE CUR. (A) +0.0 -0.0
6. Discharge Current.	DISCHARGE CURRENT (A) 00.00
7. Rectifier Input Voltage (all three phases).	RECTIFIER VOLTAGE (V) 000 000 000
8. Bypass Input Voltage (all three phases).	BYPASS VOLTAGE (V) 000 000 000
9. Output Voltage (all three phases).	OUTPUT VOLTAGE (V)0 000 000 000
10. Output Current (all three phases).	OUTPUT CURRENT (A)0 0.00 00.00 00.00
11. Active Output Power (all three phases).	ACTIVE POWER (KW) 00.00 00.00 00.00
12. Reactive Output Power (all three phases).	REACTIVE POWER (kVAr) 00.00 00.00 00.00
13. Apparent Output Power (all three phases).	APPARENT POWER (KVA) 00.00 00.00 00.00

DESCRIPTION	LCD-DISPLAY
14. Output Power (all three phases).	OUTPUT POWER (%) 00.00 00.00 00.00
15. Battery capacity.	BATT. CAPACITY (%) 00.00

Commands menu screen

DESCRIPTION	LCD-DISPLAY
1. Transfer Load to inverter.	→ LOAD TO INVERTER LOAD TO BYPASS
2. Transfer Load to bypass.	→ LOAD TO BYPASS PERFORM BATT.TEST
3. Battery Test.	→ PERFORM BATT.TEST PERF. DEEP BATT.TEST
4. Deep Battery Test	→ PERF. DEEP BATT.TEST ABORT BATT.TEST
5. Abort Battery Test.	→ ABORT BATT.TEST PERF. ALARM TEST
6. Perform Alarm Test.	→ PERF. ALARM TEST NO MORE COMMANDS

UPS Data menu screen

DESCRIPTION	LCD-DISPLAY
1. These general UPS Data are installed at the manufacturing plant.	UPS SERIAL NUMBER nn-nnnnn
2. Manufacturing date.	DATE OF MANUFACTURE 15/01/2014
3. EPROM Version.	EPROM VERSION V.V CCCC
4. Hardware Version	HARDWARE VERSION 00000000
5. Dynamic Password	DYNAMIC PASSWORD YES/NO
6. Actual Date and Time.	DATE TIME dd-mm-yyyy hh:mm:ss

Set-up user menu screen

DESCRIPTION	LCD-DISPLAY
1. Set-up language.	→ SET LANGUAGE SET DATE AND TIME ENGLISH FRANCAIS DEUTCH DUTCH SPANISH POLISH PORTOGUESE
2. Set-up Date and Time.	→ SET-UP DATE/TIME SET-UP BATT. TEST DD-MM-YY HH-MM-SS
3. Set-up battery test.	→ SET BATTERY TEST SET GENERATOR OP. DAY OF MONTH (1-31) HOUR OF DAY (0-23) REPETITIVE (Y/N) YES/NO
4. Set-up operation with Gen-Set.	→ SET GENERATOR OP. NO MORE SETTINGS BATT.CHARGE LOCK (YES/NO) BYPASS LOCK (YES/NO)

Set-up service menu screen

DESCRIPTION	LCD-DISPLAY
1. This Menu is reserved for authorized service engineers. It is not to be used by end-users.	→ SET-UP SERVICE PASSWORD
2. Type in password.	→ PASSWORD*

Key Point: It is essential to enter the password.

From within the SET-UP SERVICE menu a service engineer can adjust the UPS voltages, frequencies, currents, power and autonomies, together with setting up:

- UPS Rated Power
- Module configuration S, P01, P02…
- Single (standard) or Dual input feed
- Frequency-converter, 50/60Hz and 60/50Hz
- Synchronisation window (2-4%)

2.6 UPS Communication interface

The UPS provides various input/output communication interfaces that can be used by the customer for remote monitoring and control purposes, together with the providing the inter-module communication signals required for parallel operation in a multi-module system.

The module interface connections are made available on the Communication Interface Board which is located in the lower right-hand corner of the UPS.

Figure 2.8 shows a photograph of the Communication Interface Board with the Parallel Adapter Board fitted. A detailed explanation of the interface facilities is contained in the Options chapter of this manual.

A	SLOT 2 – for optional USB and Relay card. Provides customer outputs.
B	*JD6 – Parallel Adapter Board output cable to the next module in the parallel chain.
C	*SW2-2 – Parallel configuration DIP switch located on Parallel Adapter Board.
D	*JD5 – Parallel Adapter Board input cable from the previous module in the parallel chain.
E	SW1-9 – Multi cabinet configuration DIP switch.
F	SW2 – Module selector switch used in conjunction with Multi-Drop configuration
G	Multi-Drop (RJ45) – used to interconnect parallel modules to allow the system to be remotely monitored over ethernet.
H	X1 – Customer inputs via Pheonix terminals.
I	LEDs – red and green indicate the Customer interface board operational status.
J	JD1 – RS232 user interface to PC for monitoring and control purposes.
K	SLOT-1 – Optional SNMP card interface facility.
L	*Parallel Adapter Board

**This photograph shows the Parallel Adapter Board installed. This board, which is used only in a parallel system, plugs into JD8 on the Communication Interface Board and secured in place by 2 screws, as shown.*

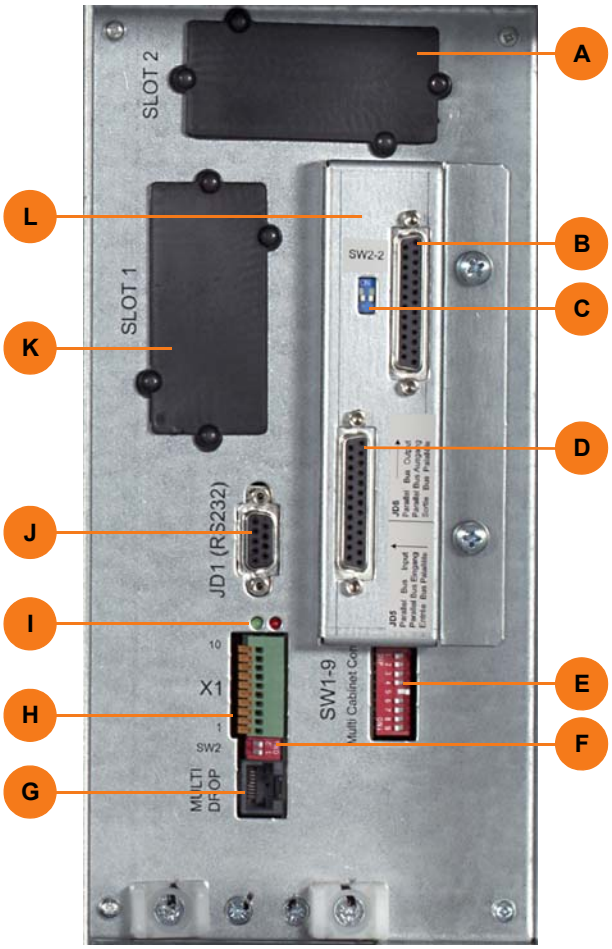


Figure 2.8 Communication interface facilities

Extended Service enquiry form

Fax to: 01256 386701 ***www.upspower.co.uk***

Uninterruptible Power Supplies Ltd.
Woodgate
Bartley Wood Business Park
Hook
Hampshire
RG27 9XA
Tel: 01256 386700

Name: .....
Job Title: .....
Company: .....
Address: .....
.....
.....
.....
Post Code .....
Tel. .....
Fax. .....
E-mail .....

Please contact me to discuss:

☐ Extended Warranty options for my PowerWAVE PW6000 S3 UPS

☐ Extended warranty options for my UPS System as below:

Manufacturer:.....
Model Nº:.....
Rating kVA:.....

☐ Replacement Batteries.....

☐ Other .....(please specify)

Thank you for your enquiry, which will receive our prompt attention.
If you need to contact us immediately call free on,

Freephone 0800 731 3269

or E-mail us on service@upspower.co.uk
www.upspower.co.uk

3 Installation

3.1 Introduction

This chapter contains essential information concerning the unpacking, positioning, installing and cabling of the PowerWAVE PW6000 S3 UPS.

WARNING: All cabling operations must be supervised by an authorised electrician or other suitably qualified person. All installation and operating procedures must be carried out in strict accordance with the instructions contained in this manual. Uninterruptible Power Supplies Ltd. will take no responsibility for any personal injury or material damage caused by the incorrect installation, cabling or operation of this product.

WARNING: Once the UPS equipment is installed it must be commissioned by an engineer approved by Uninterruptible Power Supplies Ltd. before it is powered-up. Uninterruptible Power Supplies Ltd. will take no responsibility for any personal injury or material damage caused by the application of electrical power to this equipment before it has been fully commissioned.

3.2 Taking receipt of the UPS

The UPS cabinet and accessories are delivered on purpose designed pallets that are easy to off load and move using a forklift or suitable pallet jack.

CAUTION: Observe the following precautions when off-loading and moving the UPS:

- *Always keep the packages in an upright position.*
- *Do not drop the equipment.*
- *Due to the high-energy batteries involved and heavy weight, do not stack the pallets.*

The standard packaging protects the UPS from mechanical and environmental damage during transit. This protection is further increased by wrapping the UPS with a plastic sheet. Additional packaging in the form of a wooden crate is used for sea freight.

Upon receiving the UPS you should carefully examine the packing container for any sign of physical damage. The external 'Tiltwatch' indicators (2 off) should be intact if the equipment has been correctly transported in an upright position. If the packaging has been ruptured in transit, or if a 'Tiltwatch' indicator is red, inform both the carrier and Uninterruptible Power Supplies Ltd. immediately

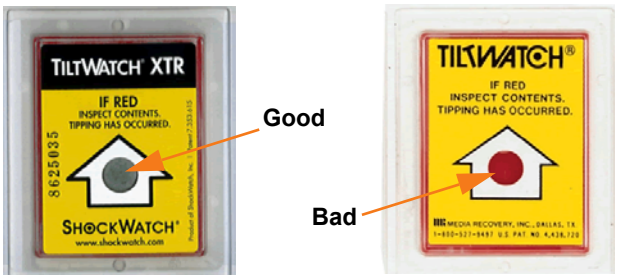


Figure 3.1 Tiltwatch indicators

CAUTION: Claims for visible shipping damage must be notified to the carrier immediately on receipt. Other shipping damage claims must be filed immediately when found and the carrier must be informed within a maximum of 7 days following receipt of the equipment.
If shipping damage is discovered you must store all packing materials for further investigation.

Ensure that the received UPS equipment corresponds to the description indicated in the delivery note.

3.2.1 Site transportation

Please observe the following precautions when you transport the UPS equipment from the off loading site to its intended installation (or storage) location.

CAUTION: Transportation:

- *Do not remove the shipping packaging until the UPS/Battery cabinet has been moved to its intended installation location.*
- *Do not at any time tilt the cabinet by more than 10° from vertical.*

CAUTION: Potential dangers:

- *If the UPS/battery cabinet is tilted by more than 10° it could cause internal damage. If tilting occurs do not connect the UPS to the mains electrical supply.*
- *The weight of the UPS/battery equipment can cause serious personal injury and/or structural damage to the surrounding area if dropped in transit. Always take extreme care when handling the equipment.*

CAUTION: Storage:

- *If the UPS is to be stored before installation it must be stored in its original shipping packaging.*
- *The recommended storage temperature for the UPS system and batteries is shown below*

3.3 Storage

UPS Cabinet

If you plan to store the UPS cabinet prior to use it should be held it in a clean, dry environment with a temperature between –25°C to +70°C and RH <95% (non condensing). An ideal storage temperature between is +20°C to +25°C.The UPS should be stored in the original packing and shipping carton. If the packing container is removed you must take measures to protect the UPS from dust.

Battery

The UPS uses sealed, maintenance-free batteries whose storage capacity depends on the ambient temperature. It is important not to store the batteries for longer than 6 months at 20°C, 3 months at 30°C, or 2 months at 35°C storage temperature without recharging them.

For longer term storage the batteries should be fully recharged every 6 months @20°C.

CAUTION: Sealed batteries must never be stored in a fully or partially discharged state.
Extreme temperature, under-charge, overcharge or over-discharge will destroy batteries!

- *Charge the battery both before and after storing.*
- *Always store the batteries in a dry, clean, cool environment in their original packaging.*
- *If the packaging is removed protect the batteries from dust and humidity.*

3.4 Unpacking

Removing the standard UPS packaging *(see Figure 3.2)*

1. Remove the plastic film from the UPS, by cutting it where there is a cardboard fillet underneath (A),
2. Carefully remove the 4 cardboard edge protectors (B) while taking care that the accessory package (C) placed on top of the UPS does not fall off.
3. With the aid of a suitable stool or step ladder, carefully retrieve the accessories package (C) – which should contain a user manual, 2 painted kick-plates (with screws), 4 feet and a set of door keys.
4. Remove the bubble wrap and securing tape (D).
5. Remove the front and back fixing bars (E) by unscrewing 8x M8 hexagonal screws (F).
6. Mount the 4x adjustable feet (G) (from the accessory package) and secure using 4x M8 tensilock nuts (H).
7. Place the UPS in its final position, them disassemble the left and right securing brackets (I) by removing the 8x M8 screws (J).
8. Fit the kick-plates (K) (from the accessories package) to the lower front and back of the cabinet and secure it using the screws provided (L).

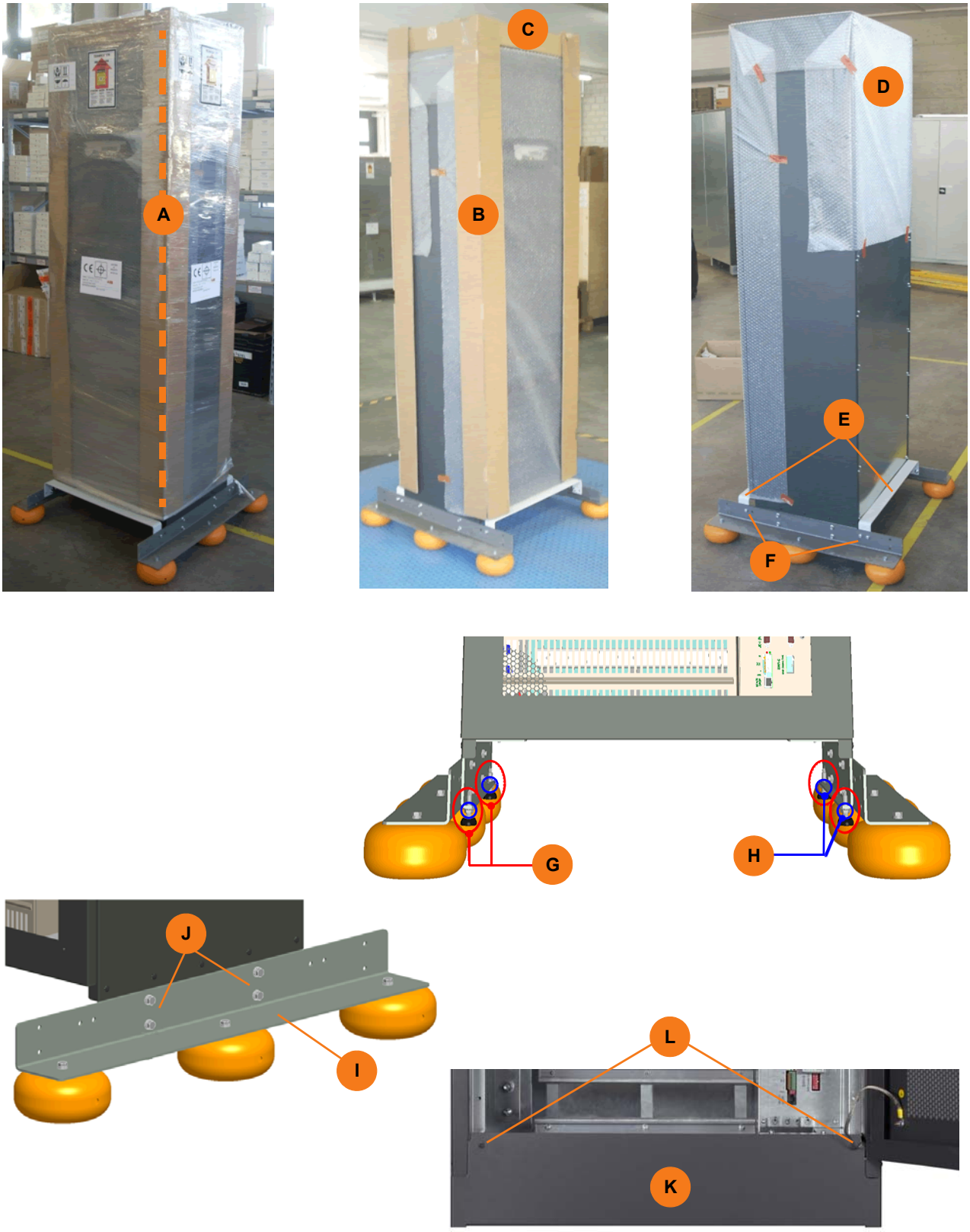


Figure 3.2 Unpacking the UPS cabinet (standard packaging)

Removing the sea freight UPS packaging *(see Figure 3.3)*

1. Disassemble the wooden box (A) by removing all screws.
2. Remove the plastic film and bag (B) from the UPS, by cutting it away without damaging the cabinet.

   Note: the edges are not protected by a cardboard fillet as in the standard packaging.
3. Remove the accessories package – which should contain a user manual, 2 painted kick-plates (with screws), 4 feet and a set of door keys – from its shipping location beneath the cabinet.
4. Using the keys from the accessories package, open the door of the UPS then remove the humidity absorbent strip inside the front of the cabinet (D) by tearing it away.
5. Similarly, remove the humidity absorbent strip from the back of the UPS cabinet.
6. Following steps 6 to 8 in previous procedure *(Removing the standard UPS packaging)*, fit the UPS adjustable feet and front/rear kick-plates.

Figure 3.3 Unpacking the UPS cabinet (sea freight packaging)

3.5 Planning the installation (site considerations)

A certain amount of pre-planning will help ensure a smooth and trouble-free installation of the UPS system. The following guidelines should be taken into account when planning a suitable UPS location and operating environment.

1. The route to the installation location must allow the equipment to be transported in an upright position.
2. The floor at the proposed installation site and en-route from the off-loading point must be able to safely take the weight of the UPS and battery equipment plus the fork lift during transit.
3. Locations with high ambient temperature, moisture or humidity must be avoided.
   a) The installation site humidity should be <95% non-condensing.
   b) The prescribed ambient temperature is 0°C to +40°C. An ambient temperature of 20°C to 25°C is recommended to achieve a long battery life.
   c) The prescribed cooling air flow must be available. The air entering the UPS must not exceed +40°C.
   d) The air conditioning system must be able to provide a sufficient amount of cooling air to keep the room within the prescribed temperature range.
4. The following environmental conditions should also be considered:
   a) Fire protection standards must be respected.
   b) The location must be free of dust and corrosive or explosive gases.
   c) The location must be vibration free.
   d) If the UPS is located in bayed enclosures, partition walls must be installed.
   e) The available space must permit the minimum cabinet clearances shown below.

3.5.1 Clearances

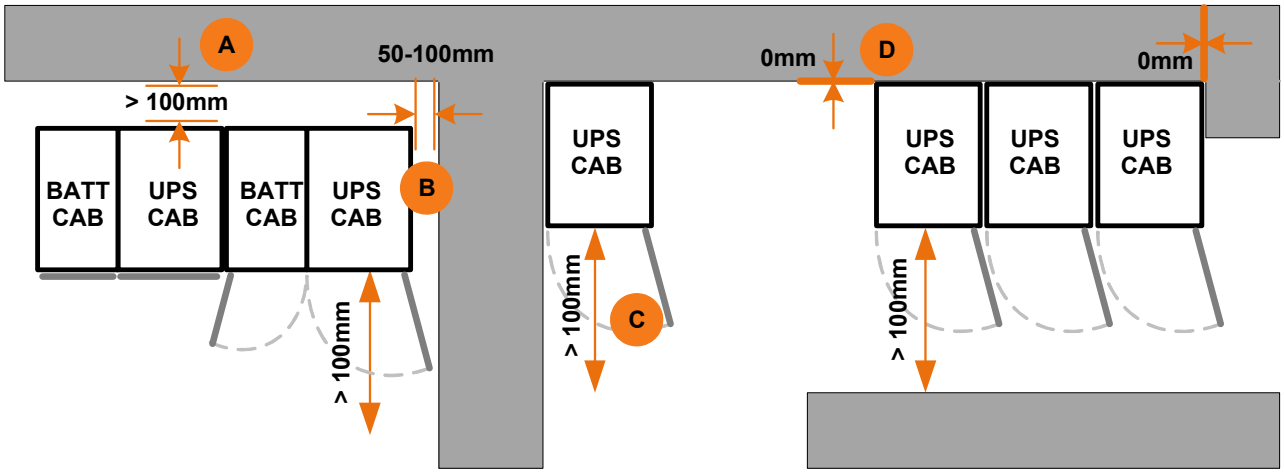


Figure 3.4 UPS Cabinet access space requirements

Figure 3.4 illustrates the space requirements when installing a single or multi-module PowerWAVE PW6000 S3 system, with or without an adjacent battery cabinet(s). All cables enter the UPS via the bottom of the cabinet no service/installation access is required from the rear or sides of the cabinets. All cabinets are force-cooled by top-mounted extraction fans which require a minimum of 400mm space at the top of the cabinet to allow adequate exhaust air flow.

A minimum of 1000mm clearance is required at the front of the cabinets for service access (C), and where possible this should be increased to allow safe passage in front of the UPS with the doors open.

The cabinet(s) do not rear or side clearance (D). However, it is necessary to open the door by slightly more than 90º to gain access to some components, so if the cabinet is located adjacent to a partition or wall that extends beyond the front of the cabinet (B) a side clearance of 50-100mm (B) should be provided between the cabinet and the partition/wall to allow the doors to open adequately. Note that if this is not possible the doors have been designed to be easily removable to aid the required internal access.

If a battery cabinet forms part of the UPS suite it is normally situated immediately adjacent to the UPS cabinet and requires a minimum rear clearance of 100mm to allow adequate ventilation (A).

3.6 Planning the installation (cabling considerations)

3.6.1 General requirements

The information in this section should help with the preparation and planning of the UPS power cabling.

IMPORTANT NOTE: The UPS does not contain internal fuses to protect the bypass and rectifier mains inputs. It is the customer's responsibility to ensure the UPS external supply fuses (or other devices) are correctly sized to provide the recommended level of UPS protection. We also recommend that a spare set of fuses are held locally to ensure they are easily available if required.

The UPS input and bypass terminals should be connected to the utility mains supply through a suitable LV-Distribution board containing a circuit breaker or fused isolator to provide suitable overload protection and a means of isolating the UPS from the mains supply when required. Similarly, the UPS output supply terminals should be connected to the load equipment via a suitably fused load distribution board.

Input neutral grounding

A permanently connected input neutral is required to enable the rectifier to operate correctly and allow the UPS to function properly when operating on battery. The input neutral must also be grounded to permit correct operation when the UPS is running on battery.

Key Point: As the input neutral must be unswitched and connected to the UPS at all times, a 4-pole input switch or isolator must not be used at the LV Distribution board on a TN-S system.

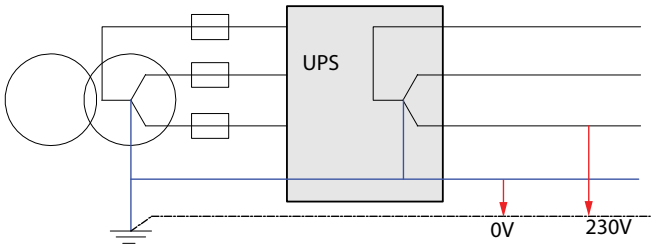


Figure 3.5 Input neutral grounding

3.6.2 Cable and fuse sizing

Single feed / Dual feed inputs

The UPS can be wired for a 'single feed' input (standard), whereby the UPS input mains terminals and bypass mains terminals are internally linked; or it can be wired for a 'dual feed' input, where the UPS bypass mains terminals are connected to a dedicated bypass supply.

Both configurations are shown in Figure 3.6 (single feed) and Figure 3.7 (dual feed) together with details of the recommended fuse and cable ratings.

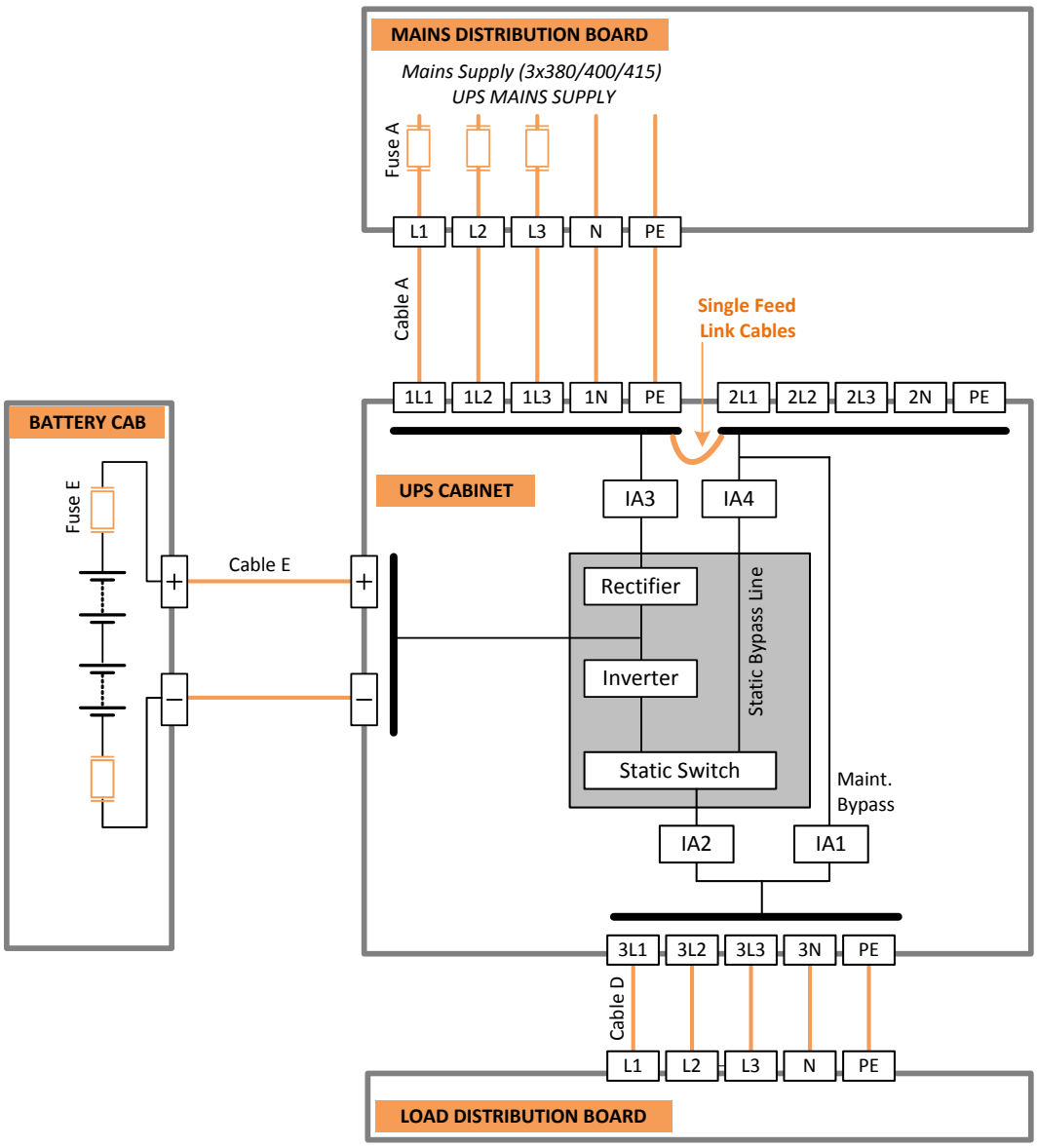
Key Point: The information in figures 3.6 and 3.7 is given for guidance only:

- Fuse and cable recommendations are to IEC 60950-1:2001.
- All external fuses, isolators and power cables must be rated and installed in accordance with the prescribed IEC standards or local regulation – e.g. BS7671:2008.
- External DC Cables and battery fuses are bespoke to the installation.

Battery fuses and cables

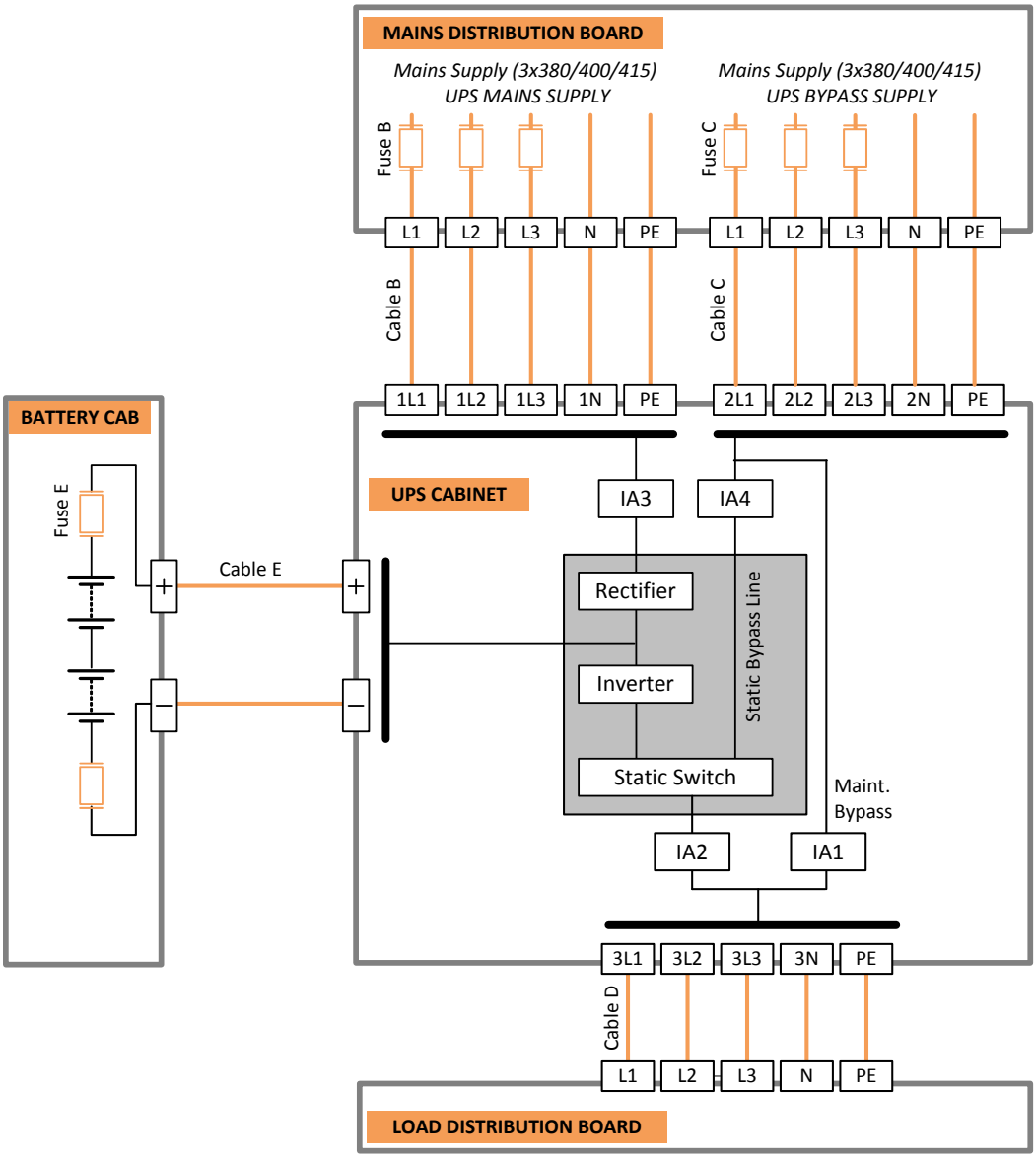
Figure 3.6 (single feed) and Figure 3.7 (dual feed) do not show battery fuse and cable sizing details as these are bespoke to the installation. The following table is given for *guidance* only.

Power (kVA)	Fuse E (gl/CB)	Cable E (Qty x mm²)
60	2x 160A	2x (1x 50)
80	2x 200A	2x (1x 95) for 42-45 battery blocks 2x (1x 70) for 46-50 battery blocks
100	2x 250A	2x (1x 120) or 2x (2x 50)for 42-45 battery blocks 2x (1x 95) for 46-50 battery blocks
120	2x 300A	2x (1x 150) or 2x (2x 50) for 42-45 battery blocks 2x (1x 120) or 2x (2x 50) for 46-50 battery blocks



Power (kVA)	Fuse A (gl/CB)	Cable A (Qty x mm²)	Cable D (Qty x mm²)
60	3x100	5x35	5x35
80	3x125	5x50	5x50
100	3x160	5x50	5x50
120	3x200	5x70	5x70

Figure 3.6 Single feed input fuse and cable ratings



Power (kVA)	Fuse B (gl/CB)	Cable B (Qty x mm²)	Fuse C (gl/CB)	Cable C (Qty x mm²)	Cable D (Qty x mm²)
60	3x100	5x35	3x100	5x35	5x35
80	3x125	5x50	3x125	5x50	5x50
100	3x160	5x50	3x160	5x50	5x50
120	3x200	5x70	3x200	5x70	5x70

Figure 3.7 Dual feed input fuse and cable ratings

3.6.3 Power cable termination details

All the UPS input/output power cables are bolted to busbar terminals as illustrated in Figure 3.8. The table below details the maximum size of the cable terminations and the correct torque that should be applied to the termination bolts.

	Mains Input (3+N+PE)	Bypass Input (3+N)	UPS Output (3+N+PE)	Battery, Neutral, PE	Tightening Torque (Nm)
60kVA	2x M8	1x M8	2x M8 1x M10	5x M8	12.3 (M8) 25.1 (M10)
80kVA	2x M8	1x M8	2x M8 1x M10	5x M8	12.3 (M8) 25.1 (M10)
100kVA	2x M8	1x M8	2x M8 1x M10	5x M8	12.3 (M8) 25.1 (M10)
120kVA	2x M8	1x M8	2x M8 1x M10	5x M8	12.3 (M8) 25.1 (M10)

UPS Power terminals

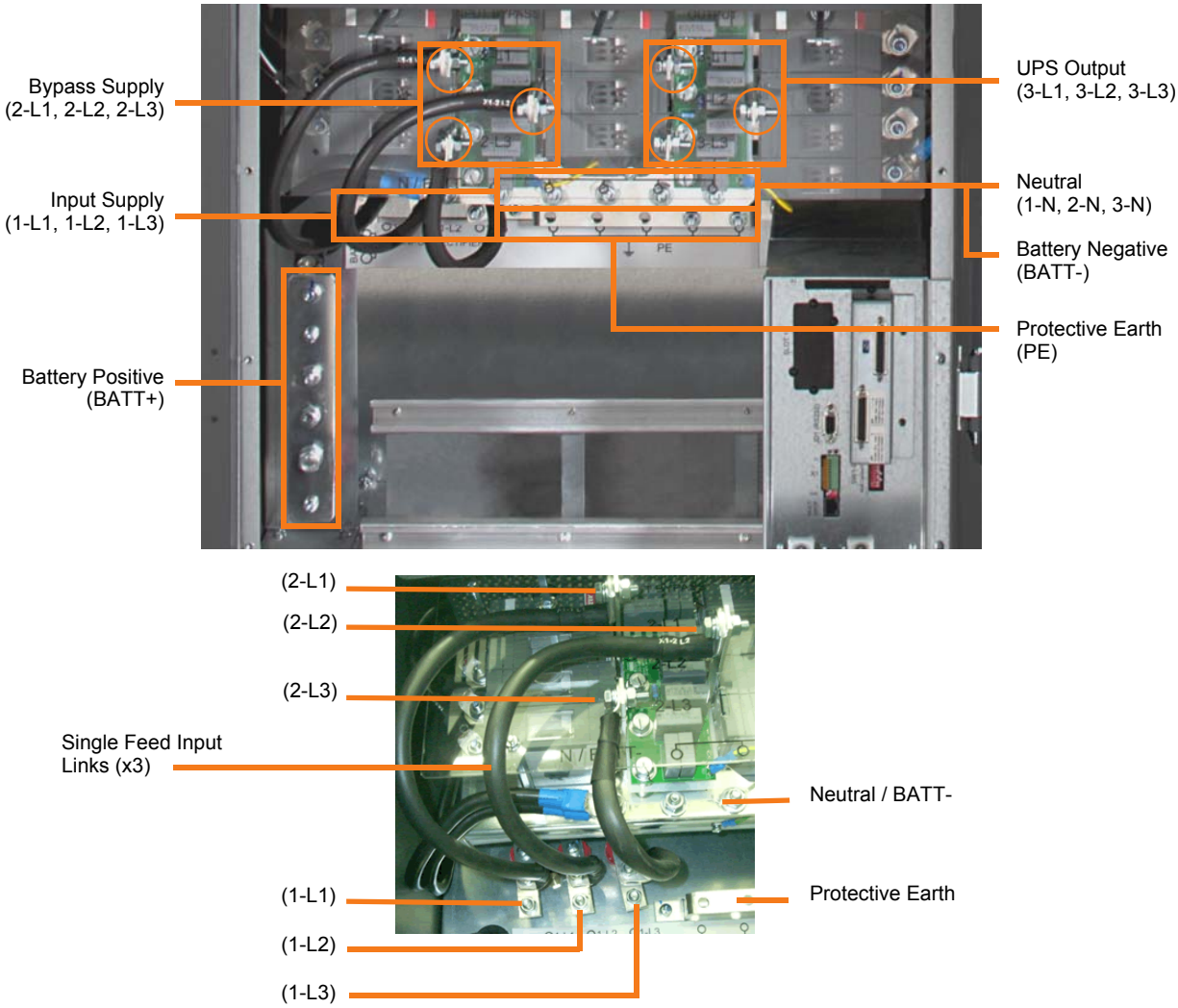
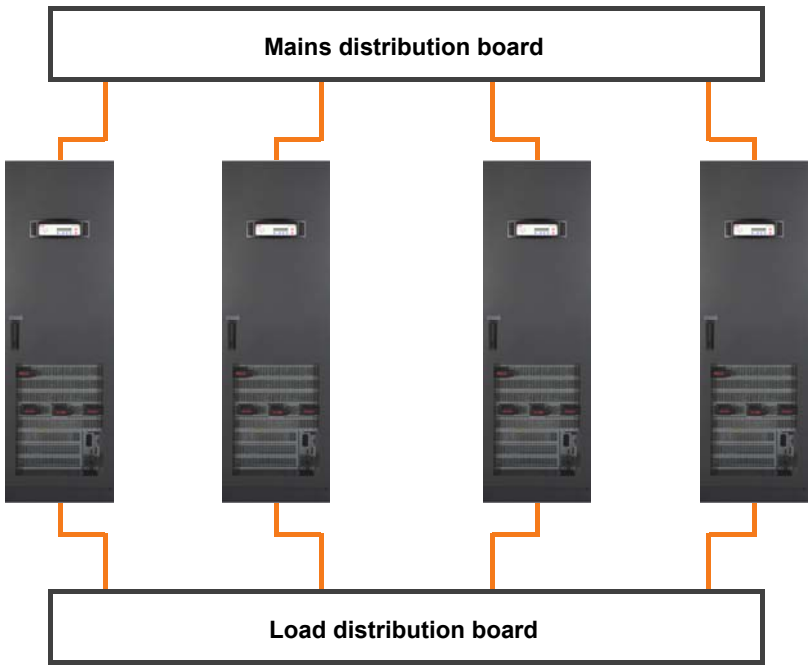


Figure 3.8 Input, output and battery power terminals

3.6.4 Power cabling in a parallel system

In order to achieve equal load sharing between the various UPS cabinets in a multi-cabinet installation, the input cables from the mains distribution board to each UPS cabinet should be of equal length. Similarly the UPS output cables to the load distribution board should be of equal length *(See Figure 3.9)*.

CORRECT



INCORRECT

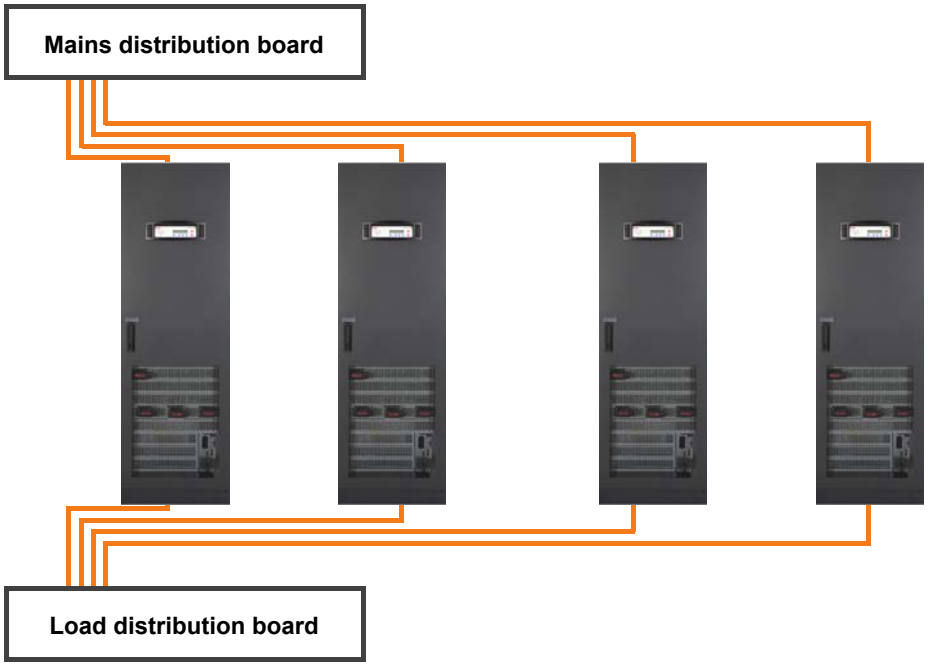


Figure 3.9 Cable lengths for multi cabinet configurations

3.7 UPS Cabling procedure

WARNING: Opening or removing the UPS-covers will create a risk of exposure to dangerous voltages if power is connected to the UPS.

Safety notes

Please ensure you read and understand the following safety notes before you begin the UPS electrical installation.

1. Do not commence this procedure until the UPS mechanical installation is completed.
2. All the cable installation procedures detailed below must be supervised by a qualified electrician.
3. Do not connect or operate the UPS if there is water or moisture present.
4. Before you work on the UPS power cables or terminals, you must ensure that the UPS input and load supplies are isolated and locked out at their respective distribution boards. Warning notices should be posted to prevent any inadvertent operation of the UPS supply isolators.
5. Before you connect the UPS input cables ensure that the customer-provided fuses and cables are suitably rated in accordance with the prescribed IEC standards or local regulations (for example BS7671:2008) – also see figures 3.6 and 3.7.
6. Once the electrical installation is completed the UPS must be commissioned by an engineer authorised by the manufacturer before it is brought into use.

WARNING: Do not apply electrical power to the UPS before it has been commissioned.

7. When installing the UPS cables ensure that the connection procedures are performed under the following conditions:
   a) No mains voltage is present at the UPS mains/bypass distribution board terminals.
   b) All loads are shut down and disconnected at the load distribution board.
   c) The UPS is fully shut down and voltage-free.
   d) The UPS Maintenance Bypass Isolator IA1 is open (OFF).
   e) The UPS Parallel Isolator IA2 is open (OFF).

3.7.1 Connecting the input cables

1. Gain internal access to the UPS:
   a) Unlock and open the UPS door.
   b) Remove the two lower cover plates to expose the power connection busbars.
   c) Remove the perspex covers from in front of the power connections to gain full access.

   Note: The connection terminals are identified on the perspex cover
2. Connect the earth cable from the mains distribution board to the protective earth (PE) busbar – see Figure 3.8.

Single Input Feed

3. Ensure the single input feed links are connected between the input supply terminals and bypass input terminals (1-L1 to 2-L1, 1-L2 to 2-L2 and 1-L3 to 2-L3) – see Figure 3.8 lower diagram.
4. Connect the UPS input supply cables to terminals 1-L1, 1-L2, 1-L3. Ensure correct (clockwise) phase rotation.
5. Connect the input neutral 1-N to the Neutral busbar.

CAUTION: The input Neutral cable must be unswitched and permanent.

6. Secure the cables to the fixing rail under the connection terminals.

Dual Input Feed

7. Remove the single input feed links if fitted – see Figure 3.8 lower diagram.
8. Connect the UPS input supply cables to terminals 1-L1, 1-L2, 1-L3. Ensure correct (clockwise) phase rotation.
9. Connect the input neutral 1-N to the Neutral busbar.

CAUTION: The input Neutral cable must be unswitched and permanent.

10. Connect the earth cable from the mains distribution board to the protective earth (PE) busbar – see Figure 3.8.
11. Connect the UPS bypass supply cables to terminals 2-L1, 2-L2, 2-L3. Ensure correct (clockwise) phase rotation.
12. Connect the bypass neutral 2-N to the Neutral busbar.

CAUTION: The bypass Neutral cable must be unswitched and permanent

13. Secure the cables to the fixing rail under the connection terminals.

Note: The UPS commissioning engineer will re-configure the UPS electronics to operated with a dual feed input at the time of commissioning.

3.7.2 Connecting the UPS output cables

It is recommended that a separate load distribution board is provided for the load.

Before you begin connecting the UPS output cables to the load distribution board:

- Check that the potential full load does not exceed the UPS output power rating (`OUTPUT POWER` on the nameplate).
- Ensure the load circuit breakers on the load distribution board are correctly sized with respect to the load rating and associated cabling.
- Ensure that the maximum total load rating, and maximum load rating of each individual load socket, is indicated on the load distribution board.

The circuit breakers must comply with the prescribed IEC Standards (e.g. BS7671:2008).

1. Gain internal access to the UPS, as described above.
2. Connect the earth cable from the load distribution board to the protective earth (PE) busbar – see Figure 3.8.
3. Connect the UPS output supply cables to terminals 3-L1, 3-L2, 3-L3. Ensure correct (clockwise) phase rotation.
4. Connect the output neutral 3-N to the Neutral busbar.

CAUTION: The output Neutral cable must ALWAYS be connected.

5. Secure the cables to the fixing rail located under the UPS connection terminals.
6. Ensure the output cables are connected to the correct power terminals on the load distribution board.

3.8 Battery connections

WARNING: The final assembly and connection of the battery installation must be carried out by the commissioning engineer. Do not attempt to fit the batteries, complete the battery wiring or close the battery isolators before the system has been commissioned

3.8.1 External battery enclosure

In a redundant system it is recommended that each UPS module is connected to a dedicated battery so that the system redundancy is expanded to also include the batteries. A range of bespoke battery enclosures can be supplied for use with the PowerWAVE PW6000 S3 UPS modules which are designed specifically to suit particular site requirements. In all cases, the battery enclosure will be fitted with suitably rated fused isolators which are connected on site to the battery terminals inside the UPS module.

Connecting the batteries

WARNING: This procedure must be carried out by (or under the supervision of) an approved UPS commissioning engineer.

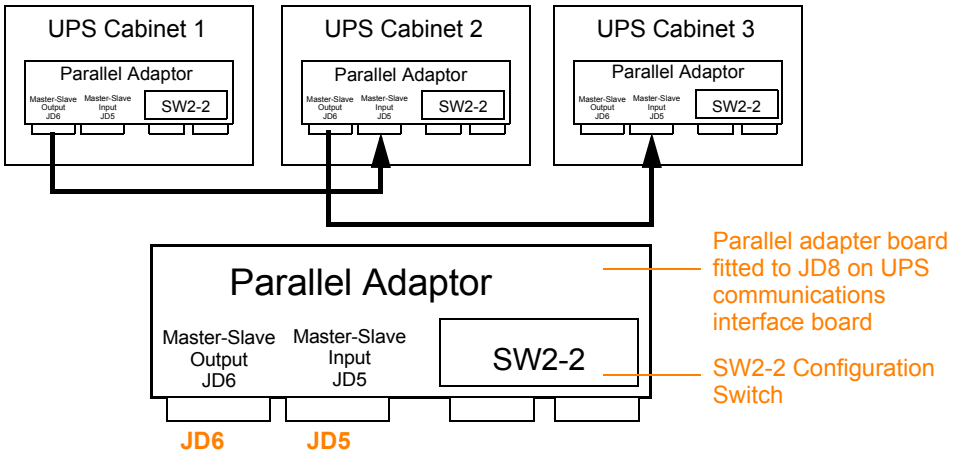
1. To protect personnel during the battery installation ensure that the connections are performed under the following conditions:
   a) No mains voltage is present at the UPS mains/bypass distribution board terminals.
   b) All loads are shut down and disconnected at the load distribution board.
   c) The UPS is fully shut down and voltage-free.
   d) The UPS and battery power connection terminals are voltage-free.
   e) The UPS Maintenance Bypass Isolator IA1 is open (OFF).
   f) The UPS Parallel Isolator IA2 is open (OFF).
   g) The battery fuses and cables must be suitably rated.
   Note that Battery fuse and cable ratings are bespoke to the installation and supplied by the customer.
2. Ensure that the fused isolators and/or circuit breakers in the external battery cabinet (or racks) are open.
3. Connect a protective earth cable (PE) between the external battery cabinet earth point and the protective earth (PE) busbar in the UPS – see Figure 3.8.
4. Connect the battery positive power cable(s) between the positive output terminal in the external battery cabinet and the battery positive (BATT+) busbar in the UPS – see Figure 3.8.
5. Connect the battery negative power cable(s) between the negative output terminal in the external battery cabinet and the Neutral (N) busbar in the UPS – see Figure 3.8.
6. Secure the cables to the fixing rail located under the UPS connection terminals and to any available securing point within the battery cabinet.

3.9 Multi-module control cabling and configuration

To facilitate various control functions such as load sharing, frequency synchronisation, and load transfer, all the UPS modules connected to a parallel system communicate with each other continuously by means of communication bus cables that are daisy-chained between each module, as shown below in figure 3.10. Once the cables are fitted, each module must be configured by means of DIP switches according to its position in the parallel system.

3.9.1 Connecting the parallel communication bus cables

1. To protect personnel during the UPS installation ensure that the connections are performed under the following conditions:
   a) No mains voltage is present at the UPS mains/bypass distribution board terminals.
   b) All loads are shut down and disconnected at the load distribution board.
   c) The UPS is fully shut down and voltage-free.
   d) The UPS and battery connection terminals are voltage-free.
   e) The UPS Maintenance Bypass Isolator IA1 is open (OFF).
   f) The UPS Parallel Isolator IA2 is open (OFF).
2. Fit a parallel adaptor board over connector JD8 on the communications interface board in all UPS cabinets and secure it in place with 2 screws, as shown in Figure 2.8.
3. The parallel adapter board contains a DIP switch (SW2-2) and two connectors, JD5 & JD6.
4. Set DIP switch SW2-2 on each parallel adaptor board according to the position of the UPS cabinet in the parallel configuration *(See Figure 3.10)*.
5. Connect a bus-cable between JD6 of UPS cabinet 1 parallel adaptor and JD5 of UPS cabinet 2 parallel adaptor.
6. Connect a bus-cable between JD6 of UPS cabinet 2 parallel adaptor and JD5 of UPS cabinet 3 parallel adaptor.
7. Continue with the above steps until a bus-cable is connected to all modules, as shown below.



	Single Cabinet	First Cabinet	Middle Cabinet	Last Cabinet
SW 2-1	ON	OFF	OFF	ON
SW 2-2	ON	ON	OFF	OFF

Figure 3.10 Bus-lines connections (3 Modules shown)

3.9.2 Configuration DIP switch selection

DIP Switch SW1-9

DIP Switch SW1-9 on the UPS communications interface board *(see Figure 2.8)* must be set to indicate the position of the cabinet in the parallel chain.

The three options are:

- First cabinet.
- Middle cabinet (there may be several 'middle' cabinets).
- Last cabinet.

1. In each cabinet, set Switch SW1-9 according to the table below:

SW1-9	First Cabinet	Middle Cabinet	Last Cabinet
1	ON	OFF	ON
2	ON	OFF	ON
3	ON	OFF	ON
4	ON	OFF	ON
5	OFF	OFF	OFF
6	OFF	OFF	ON
7	ON	OFF	OFF
8	ON	OFF	ON
9	ON	OFF	ON

4 Operation

4.1 Introduction

The PowerWAVE PW6000 S3 UPS system must be commissioned by a fully trained field service engineer authorised by Uninterruptible Power Supplies Ltd before it is put into use.

The commissioning engineer will:

- Connect the UPS batteries.
- Check the UPS electrical installation and operating environment.
- Check the UPS cabinet paralleling configuration settings.
- Check the correct installation of any optional equipment.
- Perform a controlled UPS start-up and functionally test the system for correct operation and configuration.
- Carry out customer operator training and equipment handover.

WARNING: Uninterruptible Power Supplies Ltd. accepts no responsibility for the equipment or the safety of any personnel when operating this equipment before it has been properly commissioned.

The manufacturer's warranty is immediately invalidated if power is applied to any part of the UPS system before it has been fully commissioned and handed over to the customer.

4.1.1 Operating procedure summary

Under normal circumstances all the UPS modules in a multi-module system are running and operating in their 'on-line' (on inverter) mode.

If a UPS module fails or is turned off in a redundant module system, the module will shut down but will not affect the remaining on-line modules, which will continue to supply the load with processed power. The shut-down module can then be repaired or tested off-line without affecting the remaining working modules.

If a UPS module fails or is turned off in a capacity rated (or single module) system, the module immediately shuts down and the load transferred to the static bypass supply (*in all modules*) from where it is connected to the unprotected bypass mains supply.

The UPS cabinet contains a maintenance bypass switch which, when closed, connects the cabinet's output terminals directly to the bypass mains supply. When operating via the maintenance bypass switch, the UPS modules can be repaired or tested off-line as required.

Note: All the switches and control panel operations mentioned in this chapter are identified and described in chapter 2.

This chapter contains the following procedures:

Initial system power-up and functional testing – Paragraph 4.2
System shutdown to maintenance bypass – Paragraph 4.3
System start-up from maintenance bypass – Paragraph 4.4
Individual module stop/start procedure – Paragraph 4.5

4.2 Initial system power-up and functional testing

WARNING: This procedure must be carried out by a trained engineer or service agent approved by UPS Ltd.

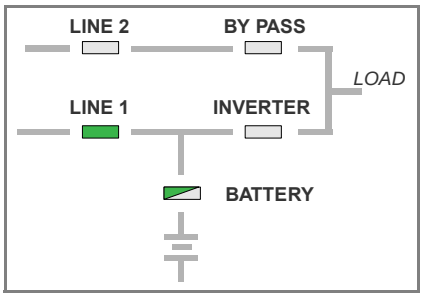
This procedure outlines the steps taken by the commissioning engineer when energising the UPS system for the first time. It can also be used to restart the system following a total shutdown.

Preliminary checks (for each UPS cabinet)

1. Check that the UPS input/bypass supply fuses or (breakers) are open (OFF) at the mains distribution board.
2. Check that the UPS power cabling has been performed correctly and the input phase rotation is correct.
3. Check that all the UPS module parallel switches (IA2) and maintenance bypass switches (IA1) are open (OFF).
4. Ensure that the UPS input isolator (IA3) and bypass isolator (IA4) are open.
5. Ensure that the battery fuses (breakers) fitted in the UPS cabinet or external battery cabinets/racks are open (OFF).
6. Check that the parallel configuration DIP switches (SW1-9) are set correctly in all cabinets (see paragraph 3.9.2).

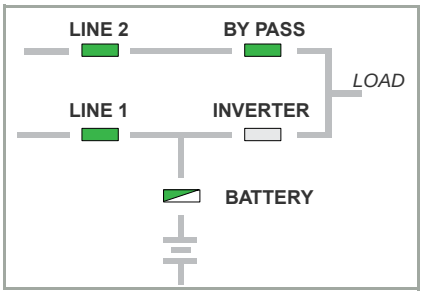
Starting the UPS modules

1. Close the UPS input/bypass supply fuses or (breakers) at the mains distribution board.
2. On the UPS module close the UPS input isolator (IA3) and bypass isolator (IA4).
   a) The UPS mimic panel LINE 1 LED will be permanent green.
   b) The BATTERY LED will be flashing green.
   c) The LCD display will indicate LOAD OFF, SUPPLY FAILURE.

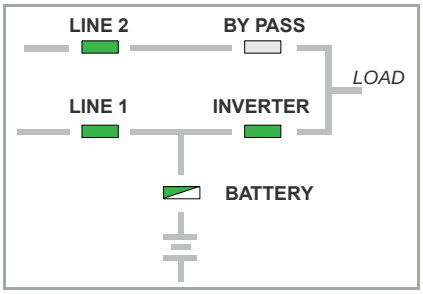


Key Point: During commissioning, the commissioning engineer can set-up the module's configuration data at this point – e.g. Set Time, Date, Module ID etc. This requires access to a password protected menu area and must be carried out only by an approved engineer.

3. Turn ON the UPS module by pressing both ON/OFF buttons simultaneously then releasing them.
   a) The UPS module will power up over approximately 60 seconds.
   b) Initially LINE 2 LED will be red, then change to green.
   c) The module control panel will display LOAD DISCONNECTED and PARALLEL SW OPEN.
   d) The module control panel mimic indications should be as shown here.



4. On the module control panel:
   a) Press the UP key once to access the menu system.
   b) Use the UP/DOWN keys to move the cursor so that it is adjacent to COMMANDS and then press the ENTER key.
   c) Use the UP/DOWN keys to move the cursor so that it is adjacent to LOAD TO INVERTER and then press the ENTER key.
   d) The UPS module output should transfer to inverter and the module control panel mimic indications should be as shown here.

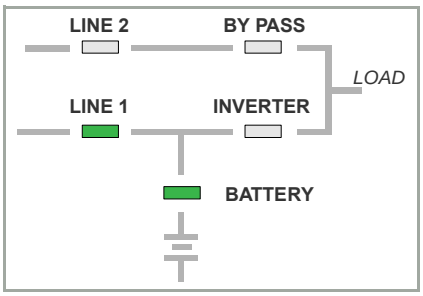


5. Scroll through the measurements menu and check that the module's input and output supply indications are correct.

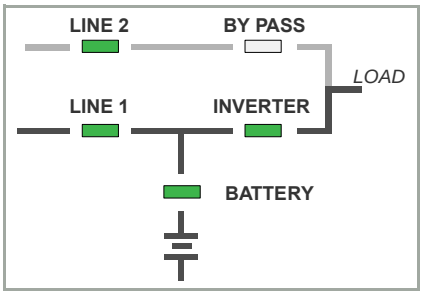
6. **In a parallel system, repeat steps 2 to 5 for all the other modules and ensure that each module is in the state shown above before continuing with this procedure.**
7. Check the battery voltage and polarity at the live side of the battery fuses/breaker located in the external battery cabinet/rack with the fuses (breaker) still open.
8. If an external battery cabinet/rack is installed, check the cabling between the UPS cabinet and battery cabinet/rack) to confirm that it is safe to connect the battery.
9. Close the battery fuses/breaker located in the external battery cabinet/rack.
10. The BATTERY led on the module control panel mimic should change from flashing to permanent green.
11. **Repeat the above steps for every UPS module so that the BATTERY led shows a permanent green on every module control panel.**

Testing the parallel function

12. Ensure that the UPS output fuses (breakers) are open (OFF) at the load distribution board.
13. Turn OFF each UPS module in sequence by pressing both ON/OFF buttons simultaneously then releasing them.
    a) The module control panel will display LOAD OFF and SUPPLY FAILURE.
    b) The module control panel mimic indications should be as shown here.

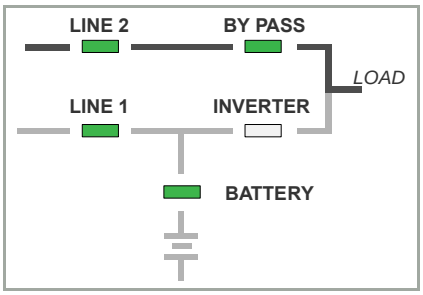


14. Close the parallel switch (IA2) in each UPS module.
    a) Each module control panel will display PARALLEL SW CLOSED.
15. Turn ON each UPS module in sequence by pressing both ON/OFF buttons simultaneously then releasing them.
    a) The UPS modules will all turn on and operate in their 'on-line' mode.
    b) There is now power at the UPS output terminals, although the load is still isolated at the output distribution board.
    c) The module control panel will display LOAD PROTECTED.
    d) The module control panel mimic indications should be as shown here.

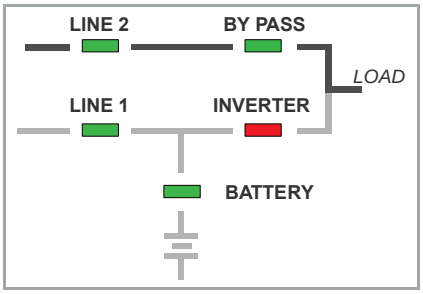


Transferring the output to maintenance bypass

16. On ANY UPS module control panel:
    a) Press the UP key once to access the menu system.
    b) Use the UP/DOWN keys to move the cursor so that it is adjacent to COMMANDS and then press the ENTER key.
    c) Use the UP/DOWN keys to move the cursor so that it is adjacent to LOAD TO BYPASS then press the ENTER key.
    d) The module control panel will display LOAD NOT PROTECTED.
    e) The module control panel mimic indications should be as shown here.



17. Close the maintenance bypass switch (IA1) (in all cabinets).
    a) The module control panel will display MANUAL BYP IS CLOSED.
    b) The system control panel mimic should show the system running on maintenance bypass.
    c) The module control panel mimic indications should be as shown here.

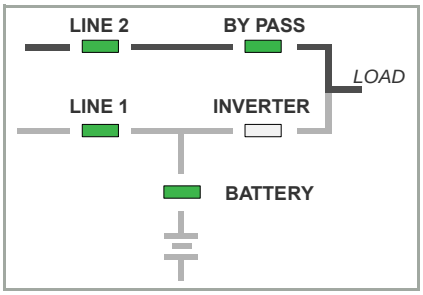


WARNING: The next action will apply mains power to the load equipment.
Check that the load is ready to receive power and that it is safe to do so before you continue.

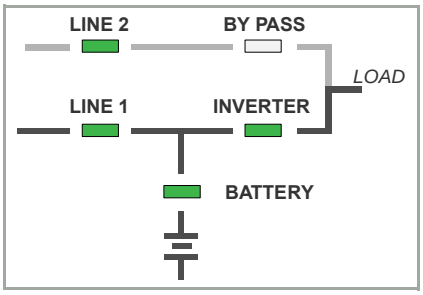
18. Close the UPS output supply fuses (breakers) at the load distribution panel.
    a) The load is now live and receiving power through the maintenance bypass circuit.

Transferring the load to the UPS

19. Ensure that the BYPASS led is green on ALL UPS module control panels.
20. Open the maintenance bypass switch (IA1) (in all UPS cabinets).
    a) The module control panel will display MANUAL BYPASS OPEN followed by LOAD NOT PROTECTED.
    b) The (red) INVERTER led will extinguish.
    c) The module control panel mimic indications should be as shown here.



21. On ANY UPS module control panel:
    a) Press the UP key once to access the menu system.
    b) Use the UP/DOWN keys to move the cursor so that it is adjacent to COMMANDS and then press the ENTER key.
    c) Use the UP/DOWN keys to move the cursor so that it is adjacent to LOAD TO INVERTER and then press the ENTER key.
    d) The module control panel on ALL modules will display LOAD PROTECTED.
    e) The module control panel mimic indications should be as shown here.



22. The UPS system is now operating in the 'on-line' mode and providing the load with protected power supplied by the modules' inverters.

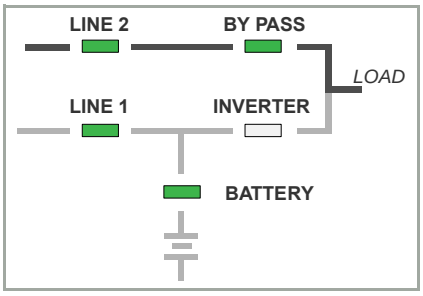
Key Point: The UPS System (single or multi-module) is now in its normal operating mode.

4.3 System shutdown to maintenance bypass

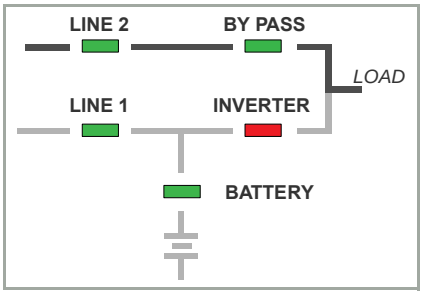
It may be necessary to transfer the load to the maintenance bypass supply to perform certain service or maintenance operations – for example, when repairing a module in a single module or capacity parallel module system.

CAUTION: Warn the critical load user that the load will not be supplied with processed, backed-up power when the UPS is operating on maintenance bypass.

1. On the UPS control panel (on any module in a multi-module system) press the ENTER key once to access the menu system.
2. Using the UP/DOWN keys, move the cursor so that it is adjacent to COMMANDS and then press the ENTER key.
3. Using the UP/DOWN keys, move the cursor so that it is adjacent to LOAD TO BYPASS and then press the ENTER key.
   a) The UPS system will transfer the load to static bypass (on all UPS modules in a multi-module system).
4. *On all modules* check and confirm that:
   a) The INVERTER LED has extinguished.
   b) The BYPASS LED is green.
   c) The LCD displays LOAD NOT PROTECTED.
   d) The module control panel mimic indications should be as shown here.



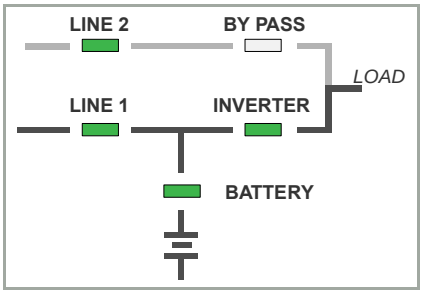
5. Close the maintenance bypass switch (IA1) (in ALL cabinets).
   a) The module control panel will display MANUAL BYP IS CLOSED.
   b) The module control panel mimic indications should be as shown here.



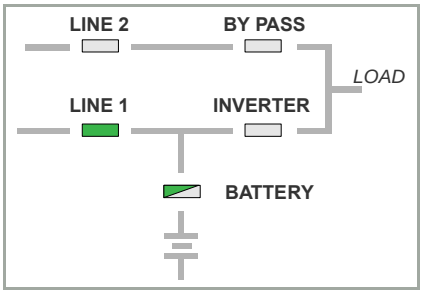
Note: The system is now operating in the 'maintenance bypass' mode with the UPS modules running but totally off-line. If you want to shut-down any (or all) the modules, continue with the procedure as follows.

To power-down a UPS module

6. Turn OFF the UPS module by pressing both ON/OFF buttons simultaneously then releasing them.
   a) The module control panel will display LOAD OFF and SUPPLY FAILURE.
   b) The module control panel mimic indications should be as shown here.



7. Open the module's parallel switch (IA2).
8. Open the battery fuses/breaker located in the external battery cabinet/rack.
   a) The BATTERY led on the module mimic should change to flashing green.
   b) The module control panel mimic indications should be as shown here.



9. Open the UPS input isolator (IA3) and bypass isolator (IA4).
   a) The module is now fully powered down.

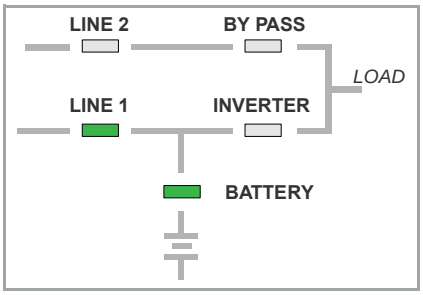
WARNING: The UPS module is still live at its input and output power terminals due to the activation of Maintenance Bypass circuit. Allow 10 minutes for the internal DC capacitors to discharge before touching any UPS internal components.

4.4 System start-up from maintenance bypass

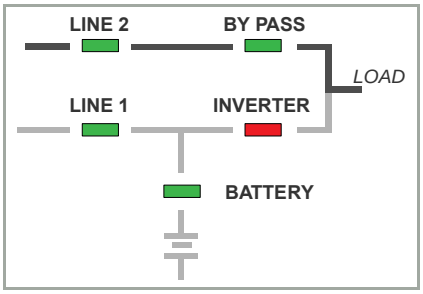
This procedure applies to both single module and multi-module systems and describes how to return the UPS system to normal (on-line) operation from working on the maintenance bypass.

Note: If all the UPS modules are already running, begin this procedure at step 5, otherwise begin at step 1 to turn on any non-working module(s).

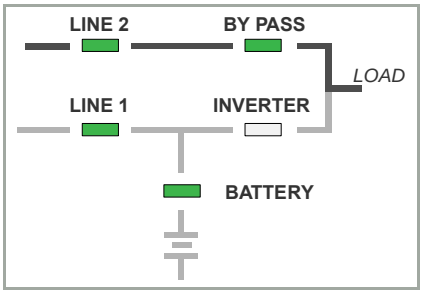
1. Close the battery fuses/breaker located in the external battery cabinet/rack.
2. Close the UPS input isolator (IA3) and bypass isolator (IA4).
   a) The module control panel will display `LOAD OFF, SUPPLY FAILURE.`
   b) The `BATTERY` led on the module control panel mimic should change from flashing to permanent green.
   c) The module control panel mimic indications should be as shown here.



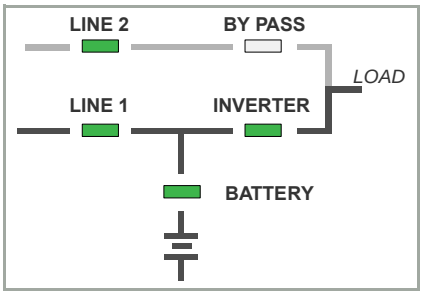
3. Close the parallel switch (IA2) for each module.
   a) The module control panel will display `PARALLEL SW CLOSED` on every module.
4. Turn `ON` the UPS module(s) by simultaneously pressing both `ON/OFF` buttons then releasing them.
   a) The UPS module(s) will start-up over about 60 seconds.
   b) The module control panel will display `MANUAL BYP IS CLOSED.`
   c) The module control panel mimic indications should be as shown here.



5. Ensure that the `BYPASS` LED is green on ALL UPS module control panels.
6. Open the maintenance bypass switch (IA1) (in all UPS cabinets).
   a) The module control panel will display `MANUAL BYPASS OPEN` followed by `LOAD NOT PROTECTED.`
   b) The red `INVERTER` LED will extinguish.
   c) The module control panel mimic indications should be as shown here.
7. Continue with this procedure only when ALL modules indicate the state shown.



8. On ANY UPS module control panel:
   a) Press the `UP` key once to access the menu system.
   b) Use the `UP/DOWN` keys to move the cursor so that it is adjacent to `COMMANDS` and then press the `ENTER` key.
   c) Use the `UP/DOWN` keys to move the cursor so that it is adjacent to `LOAD TO INVERTER` and then press the `ENTER` key.
   d) The module control panel will display `LOAD PROTECTED.`
   e) The module control panel mimic indications should be as shown here.



Note: This completes the procedure. The UPS is now operating in 'On-Line' mode and supplying protected load power.

4.5 Individual module stop/start procedure

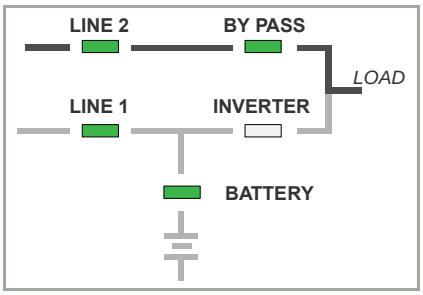
4.5.1 Single module system and capacity parallel module system

Module shutdown:

In a single module or capacity-rated parallel module system this action will automatically transfer the load to the bypass supply.

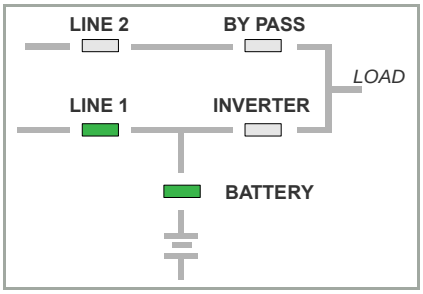
CAUTION: Warn the critical load user that the load will not be supplied with processed, backed-up power when the UPS is operating on bypass. When shutting down a single module installation if you want to maintain the load you should follow paragraph 4.3 (System shutdown to maintenance bypass).

1. On the UPS control panel press the ENTER key once to access the menu system.
2. Using the UP/DOWN keys, move the cursor so that it is adjacent to COMMANDS and then press the ENTER key.
3. Using the UP/DOWN keys, move the cursor so that it is adjacent to LOAD TO BYPASS and then press the ENTER key.
   a) The UPS system will transfer the load to static bypass (on all UPS modules in a capacity-rated parallel module system).

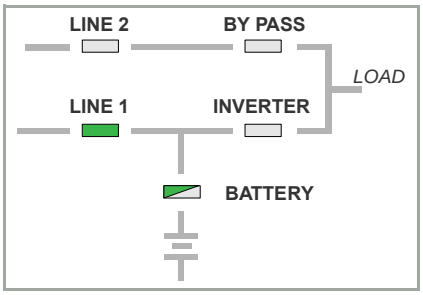


CAUTION: When performing with the next step you will lose the UPS output (load) supply in a single module installation. In a capacity-rated parallel system the remaining on-line modules will continue to power the load through the unprotected bypass supply.

4. Turn OFF the UPS module by pressing both ON/OFF buttons simultaneously then releasing them.
   a) The module control panel will display LOAD OFF and SUPPLY FAILURE.
   b) The module control panel mimic indications should be as shown here.



5. Open the module's parallel switch (IA2).
6. Open the battery fuses/breaker located in the external battery cabinet/rack.
   a) The BATTERY led on the module mimic should change to flashing green.
   b) The module control panel mimic indications should be as shown here.

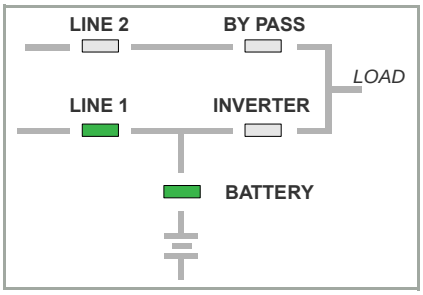


7. Open the UPS input isolator (IA3) and bypass isolator (IA4).
   a) The module is now fully powered down.

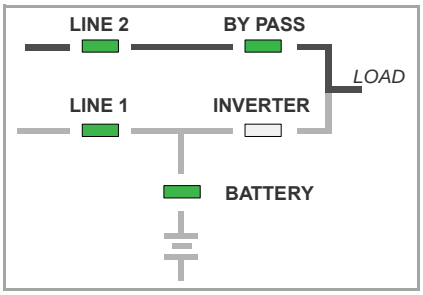
WARNING: Allow 10 minutes for the internal DC capacitors to discharge before touching any UPS internal components.

Module start-up:

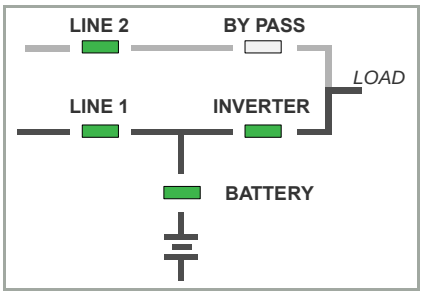
1. Close the battery fuses/breaker located in the external battery cabinet/rack.
2. Close the UPS input isolator (IA3) and bypass isolator (IA4).
   a) The module control panel will display `LOAD OFF, SUPPLY FAILURE.`
   b) The `BATTERY` led on the module control panel mimic should change from flashing to permanent green.
   c) The module control panel mimic indications should be as shown here.



3. Close the parallel switch (IA2).
   a) The module control panel will display `PARALLEL SW CLOSED`.
4. Turn `ON` the UPS module by simultaneously pressing both `ON/OFF` buttons then releasing them.
   a) The UPS module will start-up over about 60 seconds.
   b) The module control panel mimic indications should be as shown here.



5. On the UPS module control panel:
   a) Press the `UP` key once to access the menu system.
   b) Use the `UP/DOWN` keys to move the cursor so that it is adjacent to `COMMANDS` and then press the `ENTER` key.
   c) Use the `UP/DOWN` keys to move the cursor so that it is adjacent to `LOAD TO INVERTER` and then press the `ENTER` key.
   d) The module control panel will display `LOAD PROTECTED`.
   e) On ALL module control panels the mimic indications should be as shown here.



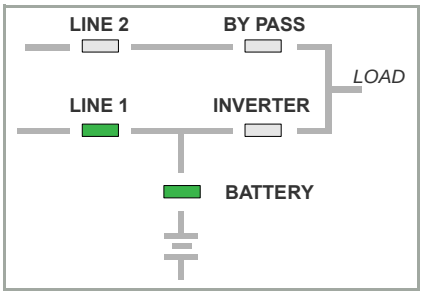
Note: This completes the procedure. The UPS is now operating in 'on-line' mode and supply protected load power.

4.5.2 Redundant parallel module system

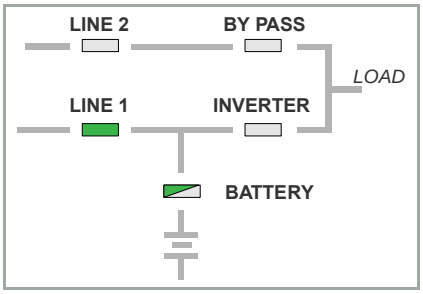
Module shutdown:

In a redundant parallel module system, one module can be shut down without affecting the load supply provided the remaining modules are operating.

1. Turn OFF the UPS module by pressing both ON/OFF buttons simultaneously then releasing them.
   a) The module control panel will display LOAD OFF and SUPPLY FAILURE.
   b) The module control panel mimic indications should be as shown here.



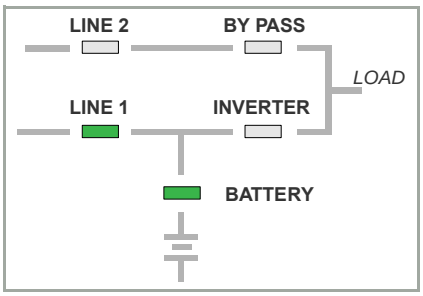
2. Open the module's parallel switch (IA2).
3. Open the battery fuses/breaker located in the external battery cabinet/rack.
   a) The BATTERY led on the module mimic should change to flashing green.
   b) The module control panel mimic indications should be as shown here.
4. Open the UPS input isolator (IA3) and bypass isolator (IA4).
   a) The module is now fully powered down.



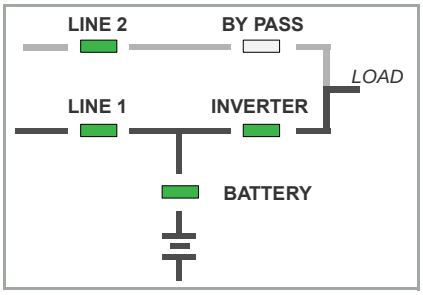
WARNING: The UPS module is still live at its input and output power terminals. Allow 10 minutes for the internal DC capacitors to discharge before touching any UPS internal components.

Module start-up

1. Close the UPS input isolator (IA3) and bypass isolator (IA4).
2. Close the parallel switch (IA2).
3. Close the battery fuses/breaker located in the external battery cabinet/rack.
   a) The module control panel will display LOAD OFF, SUPPLY FAILURE.
   b) The BATTERY led on the module control panel mimic should change from flashing to permanent green.
   c) The module control panel mimic indications should be as shown here.



4. Turn ON the UPS module by simultaneously pressing both ON/OFF buttons then releasing them.
   a) The UPS module(s) will start-up over about 60 seconds.
   b) The INVERTER will start-up and come on line (Green).
   c) The module control panel will display LOAD PROTECTED.
   d) The module control panel mimic indications should be as shown here.



Note: This completes the procedure. The UPS is now operating in 'On-Line' mode and supply protected load power.

4.5.3 Complete system shutdown

The UPS system may be shutdown completely if the load does not require power for an extended period of time. Use this procedure to totally turn of the load power and shut down the entire UPS system.

CAUTION: This procedure will totally disconnect load power. Ensure that it is safe to lose power to all the loads connected to the UPS system before you begin this procedure.

1. Isolate all load equipment connected to the output of the UPS system by opening the fused isolators or circuit breakers at the UPS load distribution panel.

WARNING: Perform the following steps only after the load has been fully isolated.

2. Carry out the following actions on every module in turn in a multi-module system.
3. On the UPS control panel simultaneously press both `ON/OFF` buttons.
   a) The LCD panel will indicate: `LOAD OFF, SUPPLY FAILURE.`
4. Open the battery fuses/breaker located in the external battery cabinet/rack.
5. Open the UPS input isolator (IA3) and bypass isolator (IA4).
6. The module is now fully powered down.
7. Open the module's parallel isolator switch (IA2).
8. Open the UPS input and bypass supply isolators (or circuit breakers) at the UPS input supply distribution panel.
9. The UPS is now voltage free.

WARNING: Allow 10 minutes for the internal DC capacitors to discharge before touching the UPS internal components.

5 Maintenance

5.1 Introduction

WARNING: The procedures described in this chapter must be performed by an authorised electrician who has received the appropriate level of training on this UPS system.

As there are no user-serviceable parts contained within the UPS the maintenance requirements are minimal. However, to maximise the useful working life and reliability of the UPS and its batteries we recommend that the UPS system and batteries are inspected and checked for calibration on a 6 monthly basis as part of a preventative maintenance schedule.

5.2 User responsibilities

The operator should inspect the UPS equipment daily to ensure that the environment in which the UPS operates is kept cool and dust free at all times, and that the operating temperature and humidity is within the limits given in the specifications chapter of this manual.

Any active alarm or status indication that indicates that the UPS is not functioning correctly should be dealt with immediately by referring to the troubleshooting chapter of this manual or contacting the manufacture's service desk.

5.3 Routine maintenance

When the UPS is commissioned, the commissioning engineer will attach a service record book to the UPS which will be used to record the UPS service history. To ensure optimum UPS operation and continuous, efficient protection of the connected load, we recommend that the system's operating parameters are checked and logged every six months, and recalibrated where necessary.

WARNING: When working inside the UPS cabinet there is a risk of exposure to potentially lethal AC and DC voltages. All work that requires internal cabinet access must be carried out by trained personnel only.

During a preventative maintenance inspection the field service engineer will check the following:

- Site environmental conditions.
- Integrity of the electrical installation.
- Cooling airflow.
- Rectifier /booster operation and calibration.
- Inverter operation and calibration.
- Static switch operation.
- Battery status.
- Load characteristics.
- Integrity of alarm and monitoring systems.
- Correct operation of all installed options.

Preventative maintenance inspections form an integral part of all Extended Warranty Agreements (maintenance contracts) offered by Uninterruptible Power Supplies Ltd.

For further details on Extended Warranty Agreements see Chapter 2.

5.4 Battery testing

A battery test sequence can be instigated from the UPS control panel and takes approximately 3 minutes to complete.

The test, which can be carried out independent of the operating mode (off-line or on-line) and whether or not the load is connected, should be undertaken only if there are no alarm indications and the battery is initially fully charged.

6 Troubleshooting

6.1 Alarms

Various UPS operating parameter and conditions are monitored and will initiate an alarm or warning notification on the UPS control panel if an error is detected. In the event that an alarm occurs you should:

1. Silence the audible warning.
2. Identify the alarm by inspecting the UPS module's 'event' register – see Page 15.
3. Interpret the cause of the alarm (see below) and seek assistance from your nearest service centre if the cause of the alarm is beyond simple rectification.

6.2 LCD Control panel

The LCD Control panel is described in paragraph 2.5.

If an alarm condition occurs, the red ALARM led will flash accompanied by an audible warning:

1. Cancel the audible warning by pressing the RESET button. If the alarmed condition was transient the audible warning will stop and the red warning light will extinguish. If the red warning remains ON it indicates that the cause of the alarm is still present and must be investigated.
2. Investigate the cause of the alarm by making a note of the EVENT LOG, which is accessed from the MAIN MENU – this will present a list of time-stamped events that took place preceding the detected alarm.
3. Access the MEASURMENTS screen from the MAIN MENU and note the value of the UPS input/output/battery parameters etc.
4. Refer to the troubleshooting table below for possible fault resolutions.

6.3 Troubleshooting table

ALARM CONDITION	MEANING	SUGGESTED SOLUTION
UPS FAULT	There is a fault in the UPS and therefore normal operation cannot be guaranteed	Call the authorised service centre for assistance.
MAINS BYP/RECT FAULT	Mains power supply is outside prescribed tolerance	The input power to UPS is too low or missing. If site power appears to be OK, check the input circuit breakers etc. supplying the UPS.
OUTPUT SHORT	There is a short circuit at the output of UPS (on load side)	Check all output connections and repair as required.
OVERLOAD	Load exceeds the UPS rated power	Identify which piece of equipment is causing the overload and remove it from the UPS. Do not connect laser printers, photocopiers, electric heaters, kettles etc. to the UPS.
OVERTEMPERATURE	UPS temperature has exceeded the allowed value	Check the ambient temperature of the UPS is less than 30° C. If the ambient temperature is normal call the authorised service centre for assistance.
BATTERY CHARGER OFF	The attached battery and the battery charger set-up do not correspond or battery charger fault	Call the authorised service centre for assistance.
INVERTER FAULT	Inverter is faulty.	Call the authorised service centre for assistance.
SYNCHRON FAULT	The inverter and mains are not synchronised.	The frequency of the input voltage to the UPS is outside operational limits and the UPS static bypass has been temporarily disabled.
BATTERY IN DISCHARGE	Battery is near end of autonomy	Shutdown load connected to UPS before the UPS switches itself off to protect its batteries
MANUAL BYP IS CLOSED	Maintenance bypass closed. Load supplied by mains	This alarm is only displayed if the UPS is on maintenance bypass

6.4 Contacting service

Uninterruptible Power Supplies Limited has a service department dedicated to providing routine maintenance and emergency service cover for your UPS. If you have any queries regarding your UPS please contact us.

Uninterruptible Power Supplies Ltd.
Woodgate
Bartley Wood Business Park
Hook
Hampshire
RG27 9XA
Tel: 01256 386700
0800 731 3269 (24 Hr.)
Fax: 01256 386701
Email: service@upspower.co.uk

We recommend that your UPS is protected by an extended warranty agreement (see Chapter 2 for details). These agreements assist us in caring for your UPS, ensuring that it is well maintained and attended to promptly should any problems occur.

7 Options

1	SLOT 2 – for optional USB and Relay card. Provide UPS/MAINS status via volt-free relay switching. USB provides an alternative RS232 output to communicate with remote computer. *(see paragraph 7.3)*
2	SLOT 1 – for optional SNMP card. *(see paragraph 7.6)*
3	JD1 – RS232 Communications for computer interface. *(see paragraph 7.3)*
4	Communications interface board operations status leds
5	X1 – Customer control inputs *(see paragraph 7.2)*
6	SW2 – Multidrop configuration DIP switch
7	MULTIDROP – JR45 multidrop cable connection *(see paragraph 7.5)*

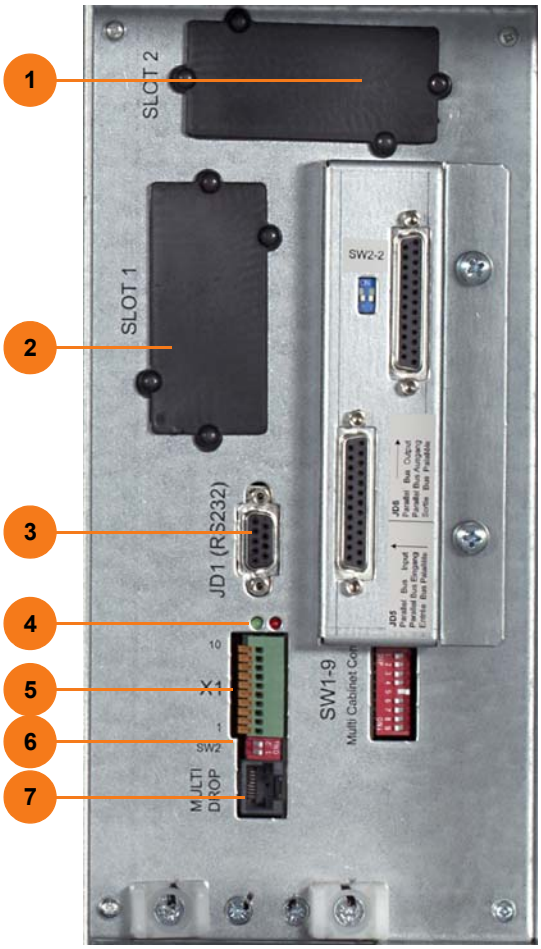


Figure 7.11 UPS Interfacing connectors

7.1 Introduction

Each UPS is fitted with a communication interface board, as shown in Figure 7.11, which enables various external monitoring and control applications to be connected to the UPS system to satisfy particular site requirements. These interfaces are described below.

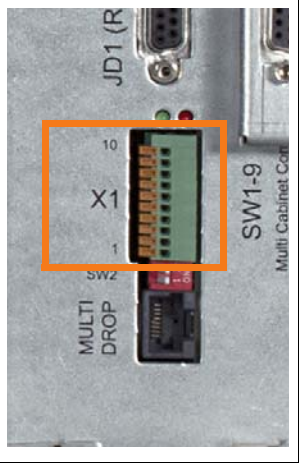
Two leds (4) are located on the communications interface board to indicate its status:

- The green led indicates the UPS cabinet's master/slave status (only one cabinet can be 'master').
  – flashing twice/sec = interface is master (1st cabinet of a parallel system).
  – flashing once/sec = Interface is slave (2nd,.. 10th cabinet of a parallel system).
- The red led signifies a board malfunction and possibly needs replacing.

7.2 Customer inputs (X1)

Terminal bock X1 provides a range of standard input interfaces that can be used by the customer as required.

All connections are made to Phoenix spring terminals using wires up to 1.5 mm².

	Terminal	Contact	Signal	Function	
X1	X1/10	Gnd	Gnd	+12Vdc Power source (max 200mA)	
	X1/9	In	+12Vdc		
	X1/8	Gnd	Gnd	REMOTE SHUTDOWN (Emergency Power Off)	
	X1/7	In	+12Vdc	(Do not remove the factory-fitted bridge if this feature is not used)	
	X1/6	Gnd	Gnd	BATTERY TEMPERATURE SENSING	
	X1/5	In	+3.3V	(If connected this input is battery temperature dependent)	
	X1/4	Gnd	Gnd	CUSTOMER SPECIFIC INPUT	
	X1/3	In	+12Vdc	(Function on request to be defined)	
	X1/2	Out	Gnd	GENERATOR OPERATION	
	X1/1	Gnd	+12Vdc	(NC = Generator on line)	

7.2.1 Remote shutdown (Emergency Power Off)

The remote shutdown facility comprises a normally-closed circuit connected between terminal X1/7 and X1/8 *(see Figure 7.12)*.

It is recommended that a terminal block, with linking facilities, is installed between the UPS and the remote shutdown button, as shown, in order to allow the removal, maintenance or testing of the remote circuit without affecting the UPS normal operation.

On a standard UPS the remote shutdown (EPO) function is disabled and a bridging link is fitted between X1/7-X1/8. If this option is required it must be activated by a hardware code on the `SETUP SERVICE` menu and the link removed.

Please contact your distributor to enable this operation.

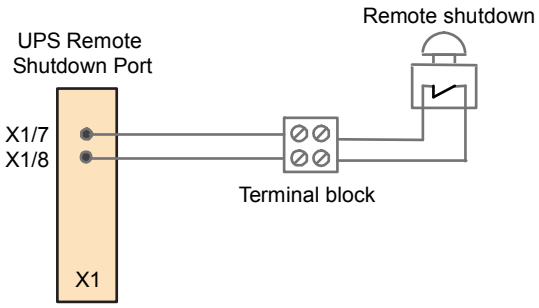


Figure 7.12 Remote emergency stop cabling

1. Use a screened cable with 1 pair (section of wires 0.5 mm^2 - 1.5 mm^2) and maximum length of 100m.
2. Connect the cable as shown in Figure 7.12.

WARNING: the UPS has an 'emergency bypass' which is automatically enabled in a single module installation. In this case the EPO function will be disabled and must be achieved in the building's facility, which must be designed to also open the bypass path.

7.2.2 Generator ON facilities

The generator ON facility must use a normally-open contact which closes when the standby generator is running and supplying the UPS input power. When used, this facility enables the option to inhibit the operation of the battery charger and/or static bypass.

1. Use a screened cable with 1 pair (section of wires 0.6 mm^2) and maximum length of 100 m.
2. Connect the cable as shown in Figure 7.2.1.

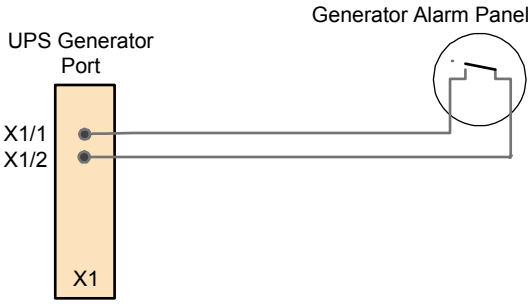
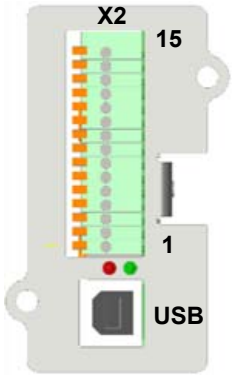


Figure 7.13 Generator ON Connection

7.3 Customer outputs (+USB)

The customer output interfaces are on an optional relay card which can be fitted to Slot 2 on the communications interface board. The relay card contains 5 relay-switched, volt-free outputs that can by connected to the external site monitoring/ BMS facilities. The relays are rated at 60VAC and 500mA and the connections are made to Phoenix spring terminals using wires up to 1.5mm².

	Terminal	Contact	Signal	Display	Function	
X1	X2/15	Com	ALARM	COMMON_ALARM	Common	
	X2/14	N/C			No Alarm Condition	
	X2/13	N/O			Common Alarm (system)	
	X2/12	Com	MES-SAGE	LOAD_ON_MAINS	Common	
	X2/11	N/C			Load On Inverter	
	X2/10	N/O			Load On Bypass (mains)	
	X2/9	Com	ALARM	BATTERY_LOW	Common	
	X2/8	N/C			Battery OK	
	X2/7	N/O			Battery Low	
	X2/6	Com	MES-SAGE	LOAD_ON_INV	Common	
	X2/5	N/C			Load On Bypass (mains)	
	X2/4	N/O			Load On Inverter	
	X2/3	Com	ALARM	MAINS_OK	Common	
	X2/2	N/C			Mains Failure	
	X2/1	N/O			Mains Present	

7.4 Serial RS232 Computer interface – USB & JD1 (Smart Port)

A serial RS 232 interface, which allows the UPS to be connected to a computer, is available through a standard 9-pin D-Type female socket (JD1) or via the USB port on the optional relay card fitted to Slot 2. Only one communication port can be active at a time and the priority is given to the USB port.

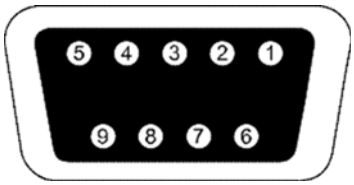
When appropriate power management software, such as WAVEMON, is installed, the computer can continuously monitor the input mains voltage and UPS status, and display a message in response to any UPS system changes.

USB Port

To establish communication between the UPS and a computer, connect the USB cable that is supplied with the UPS between the UPS USB port and the USB port on the computer. The USB port is compliant with USB 1.1 protocol.

JD1 RS232 Port

JD1 is a standard 9-pin D-Type female socket which provides an intelligent RS-232 serial port. Figure 7.14 shows the connector pinout. Note that the maximum length for the interconnecting RS232 cable is 15m.



Pin	Signal	Description	I/O
2	TXD	Transmit to external device	Output
3	RXD	Receive from external device	Input
5	GND	Ground (tied to chassis)	Input

Figure 7.14 Connector Cable - PC Serial Port

7.5 RS485 Interface for multidrop

Multidrop cables are connected between the modules to enable the system to be remotely monitored over ethernet. The cables (supplied) are terminated with RJ45 plug connectors that fit into the multi-drop socket on the communications interface board (see Figure 7.15). An RJ45 splitter plug (supplied with the fitting kit) is required when fitting the cables to the 'middle' cabinets.

1. Connect a multidrop cable between the communications interface board in UPS cabinet 1 and UPS cabinet 2, using a splitter plug in cabinet 2 if it is a 'middle' cabinet.
2. Connect a multidrop cable between he communications interface board in UPS cabinet 2 and UPS cabinet 3, using a splitter plug in cabinet 3 if it is a 'middle' cabinet.
3. Continue with the above steps until a multidrop cable is connected as a daisy chain between all modules.

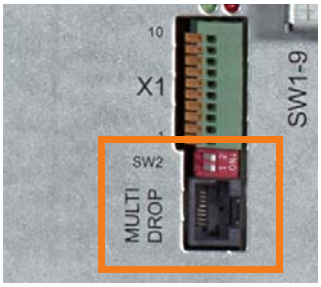


Figure 7.15 Multi-drop

7.6 SNMP Card slots

Simple Network Management Protocol (SNMP) is a world-wide, standardised communication protocol that can be used to monitor any network-connected device via a simple control language and display the results in an application running within a standard web browser.

The PowerWAVE PW6000 S3 contains an SNMP slot (SLOT 1) which is designed to house a Modem/Ethernet SNMP adapter card. Alternatively, SNMP connectivity can also be implemented using an external SNMP adapter connected to the UPS RS232 output (JD1).

The SNMP/Ethernet adapter contains an RJ-45 connector which allows it to be connected to the network using a standard network cable. Once connected, the UPS-Management software agent, which is already installed in the SNMP adapter, then monitors the UPS operating parameters and communicates the operating data to the connected PC. In a multi-module UPS system the SNMP interface can communicate 'system-wide' data or data for an individual UPS module.

The SNMP card enables event/alarm emails, server shutdown (with optional licenses) and other tasks. The SNMP card can also be integrated with BMS software over a local area network (LAN) for SNMP or Modbus information over IP. An optional card enables Modbus comms over RS485.

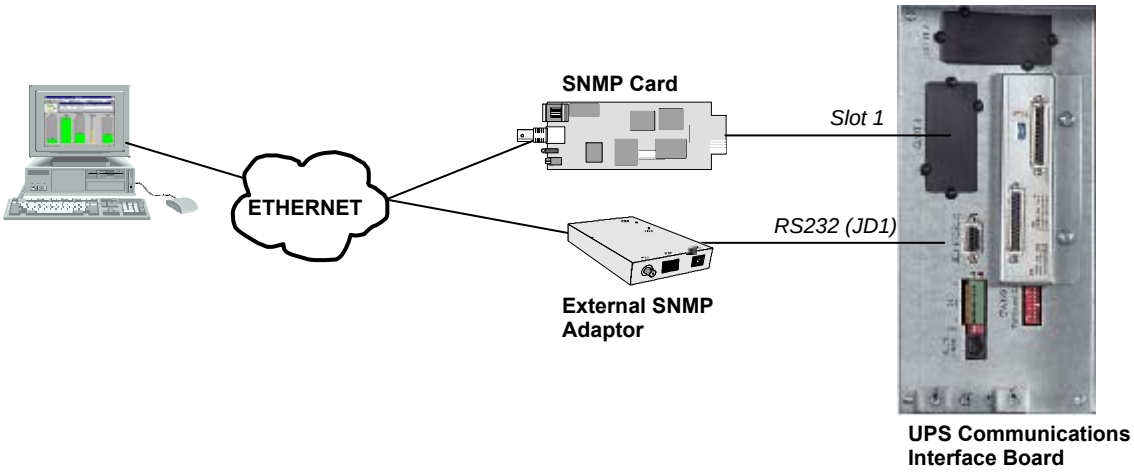


Figure 7.16 SNMP Internal and external adapters

7.7 WAVEMON Shutdown and monitoring software (instead of SNMP card)

WAVEMON is designed to operate in conjunction with many of the systems supplied by Uninterruptible Power Supplies Ltd. and features both UPS monitoring and automatic UPS/server shutdown facilities.

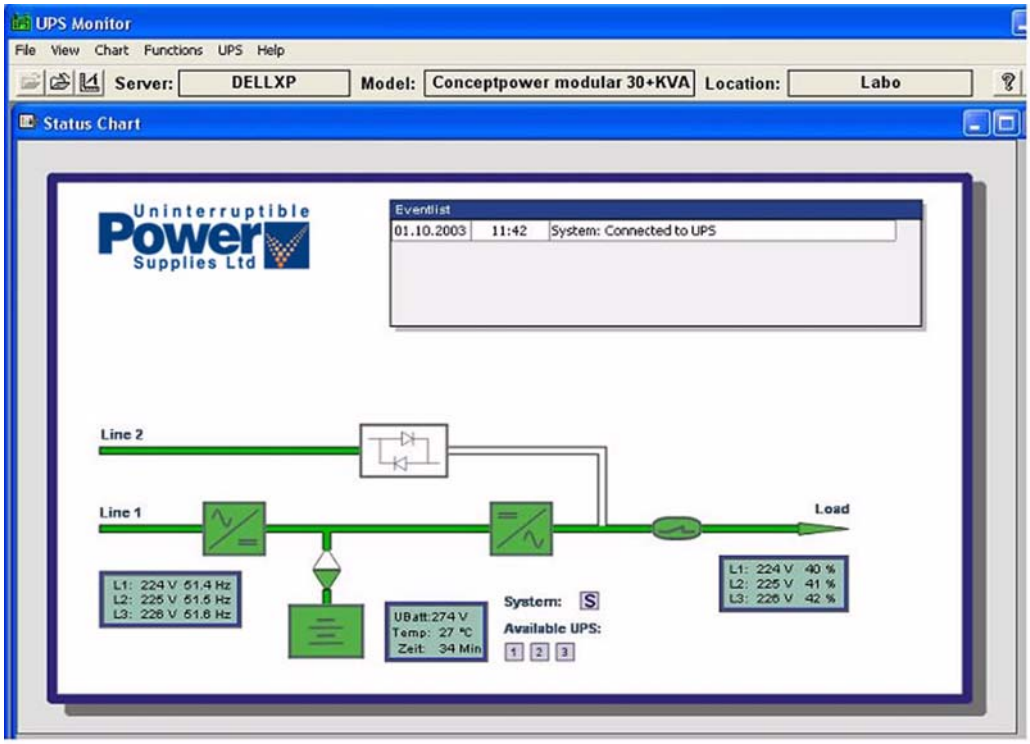


Figure 7.17 Monitoring screen image

WAVEMON comprises a bespoke software package which is installed on a local PC and communicates with the UPS via the customer interface contacts (X1-X2), optional USB port or the standard RS232 port (JD1) using a serial cable of up to 15m in length. The facilities afforded by this software can be viewed as an alternative to that offered when using the SNMP adaptor card option, and it is only required when an SNMP card or adapter box is not purchased.

The main features of WAVEMON are:

- On-screen autonomy time/battery time countdown.
- On-screen server log-off and shutdown procedure.
- Time and date stamp event log.
- Extensive logging of all UPS activity and power quality data.
- Permits alarm warnings to be monitored remotely via email.
- Scheduled UPS service mode and other systems status.
- Graphical user interface for Windows-compatible platforms.
- Automatic unattended local shutdown.
- Special modules for MS-Office software to close and save open documents.
- Compatible with all optional modules like UPSDIALER, SNMP adaptors, temperature sensors, etc.

Functional description

WAVEMON is a client/server software application for networks and local workstations. In general, it consists of two parts: the server module of the UPS management software is *UPSMAN,* which communicates with the UPS via an RS232/USB interface. Running as a background application, *UPSMAN* collects and interprets the messages received from the UPS and places them at the disposal of the client module *UPSMON,* as well as any connected SNMP-based instrumentation and control system.

If *UPSMAN* detects voltage variations or a power failure, it can execute various 'system event' routines, by means of which, for example, the server is switched off or a warning/alarm is sent to the connected users. These 'system event' routines are a part of the management software and can be configured in to suit local application requirements.

The software of your PowerWAVE PW6000 S3 UPS unit can be integrated into a network in two ways:

1. By the server which is supplied by the UPS itself and has been integrated into the network. In most cases this server is used as a sub-agent and you only need the WAVEMON software (without an SNMP adapter). You will also need to establish an RS232/USB connection between the UPS and computer/server.
2. In many cases the use of what is referred to as an 'SNMP adapter' is to be preferred in order to integrate the UPS into the network. In this case up to 50 computers can be shut down in one RCCMD environment. RCCMD (remote console command) is an additional software module that is used in order to execute a command (typically a shutdown command) in a remote system.

Licensing

A licence is issued with every software serial number for use of what is known as the 'UPS service' on a single server in connection with one UPS and an unlimited number of connected WINDOWS workstations. For operation with two or more servers, a further licence is required for each additional server. In this case it is of no importance whether the UPS service on these servers is active or whether the server was stopped by a remote UPS service. The same applies to the use of RCCMD with the 'remote send/receive' modules for 'multi-server shutdown' under NT, UNIX and other operating systems.

The service programs are generally supplied as single licences. In order to use a single CD-ROM for several 'multi-server shut-down' units you must acquire additional licence codes.

RCCMD Server shutdown

In order that remote shutdown of servers can take place, initiated by the SNMP card or WAVEMON software, further licenses must be purchased. The license is for the RCCMD client (or listening) software that resides in each target server.

7.8 PowerREPORTER™ management software

PowerREPORTER is a remote monitoring and management service which provides peace-of-mind protection by offering a continuous (24/7/365) watch over mission-critical facilities. Continuous monitoring is an affordable insurance policy to detect issues and provide an early warning before they develop into a crisis.

The main features and benefits offered by PowerREPORTER are:

- Real time email notification sent directly to UPSL Service Centre in response to alarm/critical events.
- Acquisition of key performance data and productivity information. Empowers you with the details needed to better understand machine performance and quickly troubleshoot downtime events.
- Combined with a service contract, PowerREPORTER improves service levels. The engineer can determine if site attendance is necessary and bring relevant spare parts.
- Monthly Status Report detailing trends and alarms.
- Optional battery analysis and care service; PowerNSURE - measures battery voltage, temperature, impedance and prolongs battery service life through the application of battery charge equalization.

7.8.1 Functional description

PowerREPORTER communicates constantly with your UPS system in order to automatically detect any error or alarm messages. In the event of an incident being detected, PowerREPORTER automatically connects with UPS Limited Service Centre via an email, transmitting a status message.

The email, which provides details relating to the fault, a snapshot of the UPS performance parameters and a device identification string, is automatically processed and UPS Limited Service Centre personnel are alerted.

UPS Limited Service Centre personnel are then able to liaise with the company's field service team and will remotely diagnose the UPS incident before reaching the facility with appropriate spare parts within the contracted service agreement time-frame.

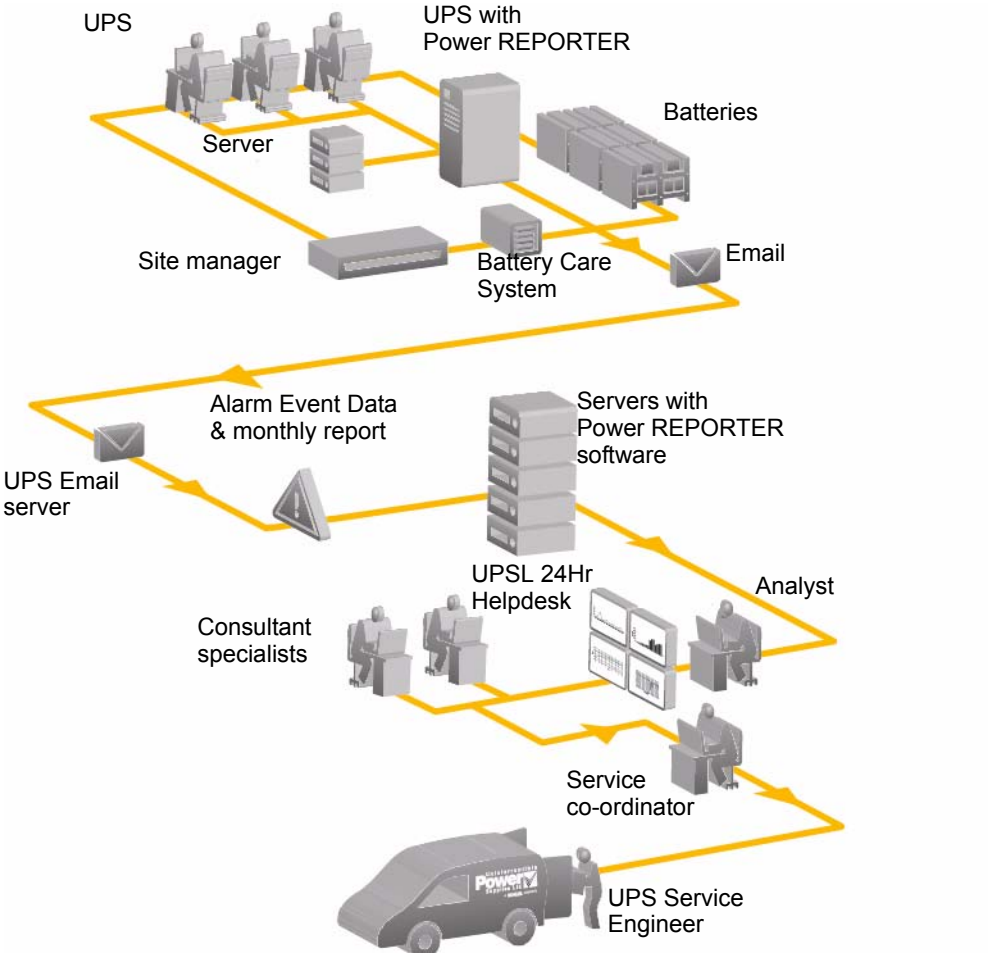


Figure 7.18 PowerREPORTER operation

8 Specification

8.1 General specifications

MECHANICAL CHARACTERISTICS 60-120kVA (No Battery Enc.)					
Rating (kVA)		60	80	100	120
Dimensions (WxHxD)	mm	615 x 1954 x 480			
Dimensions with elevation kit (WxHxD)	mm	615 x 1978 x 480			
Weight (without batteries)	kg	198	206	228	230
Colour		Graphite Grey (RAL 7024)			
Batteries		Fitted internally with optional external battery enclosure available			
Input and output power cable entry		Bottom with front access for connection			
Exhaust cooling air		Rear			

SYSTEM CHARACTERISTICS					
Topology		On-line, double conversion, Voltage and Frequency Independent (VFI)			
Technology		Second generation transformerless design			
Parallel configuration expansion		For added redundancy and/or capacity a parallel system can be extended to up to 10 modules on request			
Double conversion AC/AC efficiency with fully charged battery and linear load (PF = 1) *(Tolerance of ±0.2%)*	Load	60	80	100	120
	100%	95.5%	95.5%	95.7%	95.7%
	75%	95.8%	95.8%	96.0%	96.0%
	50%	96.0%	96.0%	96.0%	96.0%
	25%.	95.0%	95.0%	95.0%	95.0%
Eco mode efficiency	%	≥ 99.0			

INPUT CHARACTERISTICS		60	80	100	120
Nominal input voltage	V	3x 380/220V+N, 3x 400/230V+N, 3x 415/240V+N			
Input voltage tolerance (ref to 3x400/230V) for Loads in %:	V	(-23% to +15%) 3x308/177 V to 3x460/264 V for <100 % load (-30% to +15%) 3x280/161 V to 3x460/264 V for < 80 % load (-40% to +15%) 3x240/138 V to 3x460/264 V for < 60 % load			
Input frequency	Hz	35-70			
Inrush current	A	Limited by soft start			
Max. Input Power with rated output power and charged battery (pf=1.0)	kW	64	85	105	126
Max. Input Current with rated output power and charged battery (pf=1.0) [@400/230V]	A	92	122	152	183

INPUT CHARACTERISTICS (Continued)		60	80	100	120
Max. Input Power with rated output power and discharged battery (pf=1.0)	kW	70	93	116	139
Max. Input Current with rated output power and discharged battery (pf=1.0) [@400/ 230V]	A	101	134	167	201
Input power factor (leading)		≥ 0.99 @100% load			
Input harmonic distortion (THDi) (%)		≤ 4% @100% load			
Rated short time withstand current		10kA for 1.5 seconds			
AC Power distribution system		TN-S, TN-C, TN-C-S, TT			
Required input connection		3 phases an neutral required			
Rated short time withstand current		10kA for 1.5 seconds			

BATTERY CHARACTERISTICS		60	80	100	120
Battery type		Maintenance-free VRLA, vented lead-acid, NiCd			
Variable number of 12V battery blocks	No.	42-48 Autonomies >60 min are only available for loads < 90%. For loads between 90-100%, the maximum allowed autonomy is 60 mins. For autonomy's less than 20 mins UPS supports 42-50 x12 V blocks			
Variable number of 1.2V NiCd cells	No.	420-480 Autonomies >60 min are only available for loads < 90%. For loads between 90-100%, the maximum allowed autonomy is 60 mins. For autonomy's less than 20 mins UPS supports 420-500 x1.2V cells			
Max. battery charger current	A	37	49	61	61
Max. battery charger power	kW	18	24	30	30
Battery float voltage (VRLA / NiCd)	VDC	2.25 / 1.40			
End of discharge voltage (VRLA / NiCd)	VDC	1.65 / 1.05			
Temperature controlled charger		Yes (temperature sensor optional)			
Ripple current (rms)	%	2% of the battery capacity			
Battery test		Automatic and periodic (adjustable)			

OUTPUT CHARACTERISTICS		60	80	100	120
Output rated power (@min 42 battery blocks)	kVA/ kW	60/60	80/80	100/100	120/120
Load power factor rated		1.0			
Nominal output current (In) (PF=1.0) (@min 42 battery blocks)	A	87	116	145	174
Output rated voltage	V	3x 380/220 or 3x 400/230 or 3x 415/250			
Output waveform		Sinewave with 0deg. phase imbalance @100% unbalanced load			
Output voltage stability (normal/battery mode)	%	± 1.5 / ± 1.5			
Total harmonic distortion with 100% load operating in normal mode	%	< 2 with linear load			
Total harmonic distortion with 100% load operating in battery mode	%	< 2 with linear load			

OUTPUT CHARACTERISTICS (Continued)		60	80	100	120
Voltage imbalance and phase displacement with 100% load imbalance	°	0°			
Voltage transient and recovery time with 100% step load	%/ sec	< 4% (linear load)			
Output frequency	Hz	50 or 60			
Output frequency tolerance	%	±0.1 free-running, quartz oscillator ±2 or ±4 (selectable) with mains synchronised			
Frequency slew rate	Hz/s	1.0			
Max synch phase error	°	< 2° (referred to a 360° cycle)			
Permissible unbalanced load	%	100% (all 3 phases independently regulated)			
Overload capability on inverter	% / min	150% load for 30 seconds 125% load for 5 minutes 110% load for 20 minutes			
Inverter short circuit capability (x rated output for 40ms)	A	2.7x	2.0x	2.3x	1.8x
Fault clearing capability (100ms)	A	2x In for normal mode and battery mode			
Bypass short circuit capability	A	10x rated In for 10ms			
Crest factor		3:1			
Bypass operation	V	At ±15.0% of nominal input voltage			
** With 48 battery blocks only*					

STATIC BYPASS		60	80	100	120
Transfer time	ms	< 1.0 Inverter to bypass < 5.0 bypass to inverter < 6.0 in Eco mode			
Rated current	A	87	116	145	174
Bypass mode fault clearing capability	A	10x In for 20ms (with recommended fuses fitted)			
Overload protection on bypass mode	%/ min	150% load for 30 seconds 125% load for 5 minutes 110% load continuously			
Maintenance bypass		Fitted as standard			
Bypass protection fuses or circuit breaker		Not included			

ENVIRONMENTAL CHARACTERISTICS		60	80	100	120
Audible noise @ 100/50% load	dBA	< 65			< 69
Ambient temperature for UPS	°C	0-40			
Ambient temperature for batteries (recommended)	°C	20			
Battery storage time at ambient temperature		Maximum 6 months			
Fan assisted cooling air flow		Front entry, top exit			
Heat dissipation with 100% linear load	W	2850	3800	4750	5700
	BTU/h	9730	12970	16220	19460

ENVIRONMENTAL CHARACTERISTICS		60	80	100	120
Heat dissipation without load	W	410	530	640	640
Relative air-humidity		≤ 95% (non-condensing)			
Max altitude above sea level without derating		1000m (3300ft) without derating			
De-rating factor for use at altitudes above 1000m sea level according (IEC 62040-3)		Height above sea level (m/ft) 1500 / 4850 2000 / 6600 2500 / 8250 3000 / 9900			

STANDARDS	
Safety	IEC/EN 62040-1
Electromagnetic compatibility	IEC/EN 62040-2
Performance	EN 62040-3:
Product certification	CE
Degree of protections	IP20
Manufacturing	ISO 9001:2008, ISO 14001:2004

COMMUNICATION OPTIONS	
Power Management Display (PMD)	LCD display and mimic diagram showing UPS operational status
Customer Interfaces: (Dry Ports)	Volt-free output interface provide status and alarm outputs for remote indication and interfacing with BMS systems. Together with customer inputs interface for connecting an Emergency Stop, On Generator status etc.
RS232 on Sub-D9 port	For monitoring and integration in network management
RS485 on RJ45 port	Remote monitoring system with graphical display (option)
RS485 on RJ45 port	For multidrop purposes (option)
Slot for SNMP Card	Ethernet card for monitoring and integration in network management (option)
Slot for SNMP Card	USB Port and relay card. Customer outputs

8.2 60-120kVA Fuses & cables quick reference

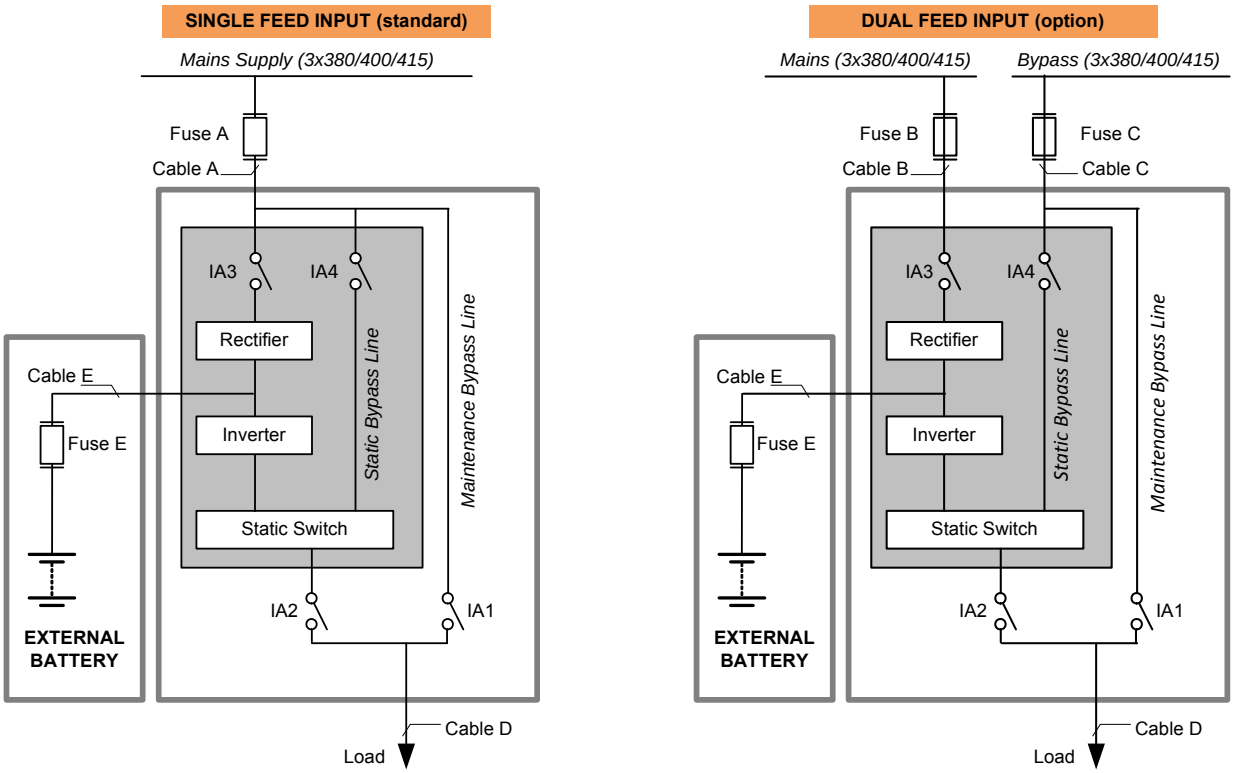


Figure 8.19 Fuse and cable ratings

IMPORTANT NOTE: The UPS does not contain internal fuses to protect the bypass and rectifier mains inputs. It is the customer's responsibility to ensure the UPS external supply fuses (or other devices) are correctly sized to provide the recommended level of UPS protection.
We also recommend that a spare set of fuses are held locally to ensure they are easily available if required.

Single feed input

Power (kVA)	Fuse A (gl/CB)	Cable A (Qty x mm²)	Cable D (Qty x mm²)
60	3x100	5x35	5x35
80	3x125	5x50	5x50
100	3x160	5x50	5x50
120	3x200	5x70	5x70

Dual feed input

Power (kVA)	Fuse B (gl/CB)	Cable B (Qty x mm²)	Fuse C (gl/CB)	Cable C (Qty x mm²)	Cable D (Qty x mm²)
60	3x100	5x35	3x100	5x35	5x35
80	3x125	5x50	3x125	5x50	5x50
100	3x160	5x50	3x160	5x50	5x50
120	3x200	5x70	3x200	5x70	5x70

Battery fuses and cable

NOTE: Battery cabling (Cable E) and battery fuses (Fuse E) are bespoke to the installation. Details given here are for guidance only.

Power (kVA)	Fuse E (gl/CB)	Cable E (Qty x mm²)
60	2x 160A	2x (1x 50)
80	2x 200A	2x (1x 95) for 42-45 battery blocks 2x (1x 70) for 46-50 battery blocks
100	2x 250A	2x (1x 120) or 2x (2x 50)for 42-45 battery blocks 2x (1x 95) for 46-50 battery blocks
120	2x 300A	2x (1x 150) or 2x (2x 50) for 42-45 battery blocks 2x (1x 120) or 2x (2x 50) for 46-50 battery blocks